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ADVANCING AGRICULTURE THROUGH RESEARCH

SEVENTY-SECOND ANNUAL REPORT

JUNE 1960 BULLETIN A-109

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SEVENTY-SECOND ANNUAL REPORT, 1958-1959

JUNE 1960 BULLETIN A-109

UNIVERSITY OF MARYLAND
AGRICULTURAL EXPERIMENT STATION
COLLEGE PARK, MARYLAND

BOARD OF REGENTS OF THE UNIVERSITY OF MARYLAND AND THE MARYLAND STATE BOARD OF AGRICULTURE

1958-1959

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In addition to state and federal funds, the research program of the University of Maryland Agricultural Experiment Station has received support during the year from many public, private and industrial organizations and individuals. It is regretted that space does not permit recognition of all sources of help, but the cooperation of all is herewith gratefully acknowledged.

Visitors will be welcome at all times and will be given every opportunity to inspect the work of the Agricultural Experiment Station in all its departments.

The bulletins and reports of the Station will be mailed free of charge to all residents of the State who request them. The more recent publications are listed on pages 66-70.

UNIVERSITY OF MARYLAND
AGRICULTURAL EXPERIMENT STATION
COLLEGE PARK, MD.

To The Governor of Maryland,
the Board of Regents,
and the President of the University of Maryland

I transmit herewith the Seventy-Second Annual Report of the University of Maryland Agricultural Experiment Station, as established by Act of Congress, March 2, 1887, containing an account of research and experiments conducted during the fiscal year ending June 30, 1959, and a statement of the receipts and disbursements for the same period.

I. C. Haut
Director

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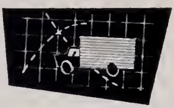
AGRICULTURAL ECONOMICS



Agricultural Economics research is devoted to activities associated with the efficient production and marketing of agricultural products. Maximum resource utilization in production and marketing practices (such as, processing, merchandising and promotions) will assure maximum returns to agriculture in an expanding economy.

Large Capital Expenditures Needed for Farm Machinery

The trend in recent years has been toward larger expenditures for farm machinery. With the high cost of farm labor, mechanization has increased at a rapid pace. Larger and more expensive farm machinery has replaced much of the hired labor used on farms, particularly during the harvest season.

The total estimated value of all farm machinery reported by 81 farm operators amounted to $510,727, an average of $6,300 per farm. Sixty-five percent of the farm operators had an investment of over $20 per acre in farm machinery, 40% had over $30 per acre invested and 10% had an investment of over $50 per acre.

The total debt for farm machinery was estimated to be less than 10% of the total value. Only 20 of the 81 farm operators reporting had short term loans to finance the purchase of farm machinery.

With the exception of tractors and farm trucks, harvesting machinery accounted for the largest total investment in farm machinery. Over half of the farm operators interviewed owned hay balers and combines, 35% owned ensilage harvesters, and 20% owned corn pickers. These machines were the most expensive pieces of farm machinery in terms of total fixed costs and total number of days used. The estimated annual cost of owning a combine is $250.65, corn picker $257.17, an ensilage harvester $223.43, and a hay baler $212.80.

Without some means of reducing the unit fixed cost, owning expensive harvesting machinery is almost prohibitive for many small farmers. Where adequate records are maintained, farmers may be able to justify owning certain pieces of equipment by adjustments in their cropping system, doing custom work or by joint ownership. In many cases, it would be more profitable to utilize custom equipment where it is available. *(Project A-19-t)*

Many Changes Noted in Dairy Farming

Many changes have occurred in the average land, livestock, machinery and purchased capital inputs of dairy farms during the past 25 years. At the same time, there was little change in the quantity of labor required on dairy farms in Maryland's Piedmont area.

Average crop acreage increased from 84 to 106 acres per farm. Cow numbers more than doubled from 17 to 37 cows, while crop acres available per cow declined from 5.0 to 2.8 acres. Increased yields per acre and increased purchases of off-farm feed contributed to the reduction in the number of crop acres available per cow. Milk sales increased from 85,000 to 255,000 pounds per farm.

Dairymen used the equivalent of an average of two full-time men to operate their businesses in 1956. One man now cares for an average of 20 cows and their replacements, in contrast to only 8 cows and their replacements 25 years ago. One man now handles 54, instead of 42 crop acres. Milk production increased from 5,136 to 7,241 pounds of 4% milk sold per cow. Pounds of milk sold increased from 43,000 to 140,000 pounds per man.

The crop acreage and the farm labor force were used more intensively as the number of cows per farm increased. Dairy farms today tend to use less labor and more capital per crop acre and per cow than 25 years ago. The use of capital permits a multiplication of effort and skill of each worker.

Many dairymen will find that both cows per man and milk sold per cow can be increased to obtain more pounds of milk sold per man. To do this, they'll need to take care of more cows as well as to practice better breeding, feeding and management.

(Project A-18-al)

Costs of Processing Vegetables Change

In the first phase of this study, 1956 cost data were obtained from 22 firms to determine the cost of canning and selling sweet corn, tomatoes, peas, lima beans, and green beans. For each commodity, costs were computed for the principal styles and can sizes. For each component cost item, the highest cost and the lowest cost was shown, in addition to the average cost for all firms packing each commodity.

The second phase of the study consisted of comparing 1956 costs with 1949 costs. Data for the earlier year were obtained in a private study conducted by the accounting firm engaged for this project, and pertained to approximately the same sample of processors as the 1956 study.

From 1949 to 1956, costs of canning and selling increased by a greater percentage than the increases in selling prices. For tomatoes, one of the major commodities, total processing costs for the #303 can size increased 53%, while the selling price increased only 38%. By component cost items, cost of raw products increased 55%, and cost of cans and other materials increased 24%. Selling costs for tomatoes increased 5 cents per dozen cans, an increase of 104 percent from 1949 to 1956.

The cost of canning and selling whole kernel golden corn in #303 cans increased 30%, whereas selling actually dropped 5% from 1949 to 1956. Processing costs, half of which consist of labor expense, increased 14 cents per dozen, or 48%. Cans and other materials increased 27%, and selling costs, 36%.

Findings of this study can be used by canning firms to observe the component cost items that have increased most, and to analyze their operations in an effort to increase efficiency in the use of the more costly resources.

(Project A-34)

Study Quality Control Practices of Vegetable Processors

Maryland processing firms are confronted with the problem of selling to fewer and larger buyers, who desire processed vegetables of uniform quality to be delivered in quantities as needed. In the past, numerous processing firms sold canned vegetables under their private label to wholesalers, who supplied retailers. With the increase in direct buying by chain stores and cooperative wholesalers, and the decrease in numbers of independent wholesalers, canners have indicated an interest in developing a group marketing organization in order to meet the requirements of larger firms.

In order to analyze the problems involved in consolidating packs from member firms, so as to attain uniform quality levels, a study of existing quality control practices was undertaken. Fifty vegetable canning firms were interviewed in the sample, which was drawn from firms in Maryland, Delaware, and Southern Pennsylvania.

Information was obtained concerning the extent of processors' control over quality of the raw product, either by growing part or all of the product themselves or by various contract specifications, such as varieties, fertilization, and other cultural practices. Other procurement operations investigated included fieldmans' activities related to checking on quality and the extent of inspection and grading as a basis for paying for the raw product.

Information was obtained on the number of sizes packed individually; proportions of total pack canned under private labels and buyers' labels, and grading of the finished product.

Analysis of this survey information should indicate possible methods of controlling quality of canned vegetables processed by individual members of a group marketing organization. Also, findings will enable canners to compare their current quality practices with those of the industry in this area.

(Project A-26-ba)

Specifications for Buying Livestock Studied

Preliminary work on this project was to determine the extent of vertical integration in the production and marketing of livestock in Maryland. A survey was made of county agents and livestock slaughter houses to obtain tentative indications of an organized effort in marketing livestock to meet certain specifications of buyers. Reports received show the need for and interest in further field study of these practices.

Selected livestock producers in the Eastern Shore and Western Maryland areas have been contacted to determine past and present experience with various types or integrated operations. It was found that at least 6 types of organized contracts were in use. Further data will need to be obtained before a conclusive report of findings can be made.

Basic information on the types of contracts used by producers and buyers will indicate the extent of integration and the possibility for further organization within the livestock industry.

(Project A-26-bb)

Appraise Market Outlets for Farm Poultry

Information for this study was obtained from poultry processing plants, commission men and hucksters, auction markets, and turkey producer-processors. Based on data obtained, processors handled the major portion of farm fowl and turkey sold direct from farm flocks. The volume of farm fowl marketed varied seasonally with the largest quantity moving in the months of September and November. Supplies were deficit during the months of March through May. This uneven supply presented a real problem in marketing poultry from farm flocks.

The heaviest marketings of turkeys occurred in November and December when turkey prices were highest, according to data obtained from this study. Apparently the increased demand for turkey during the holiday period was adequate to move large supplies offered for sale at this season of the year.

The largest outlet for processed fowl and turkey was retail stores. Wholesalers, clearing houses, and institutions were important buyers in terms of quantity purchased. Price margins were related to the channels of distribution and methods of handling.

The marketing of farm fowl and turkey constitutes an important source of income to Maryland farmers. The production of farm fowl is considered a by-product to the egg industry with little organized effort given to improving marketing facilities.

(Project A-26--ax)

Survey Made of Poultry Processing Plants

During the year a survey was made of 12 poultry processing plants in the Delmarva area. Data were obtained on plant capacity, operating volume, prices paid for raw product, dressing percentages, rate and causes for condemnations, and type of pack and size of bird leaving the plant. These data show how Delmarva processors compare with those of other major broiler areas. Poultry receipts and transportation rates were given for 12 major markets.

Results of this study show: (1) processing capacity on Delmarva is more than adequate for the number of birds raised; (2) Delmarva pays a higher price for live birds than other areas; (3) dressing percentage was quite low for the area; (4) the industry has considerable market advantage transportation-wise; (5) data on brand sold, type of pack, and market channels were related to the feasibility of marketing poultry under different methods.

Pertinent problems peculiar to the local processing industry in Maryland were clearly defined as: (1) a low dressing percentage compared to other areas; (2) an excess of processing capacity thereby increasing fixed costs; and, (3) high wage rates. The results of this study may be used in the development of a program directed toward improving the market advantage of the local industry.

(Project A-26-am)

AGRICULTURAL EDUCATION

Agricultural research is conducted for the purpose of gaining new knowledge which will help people. Research in agricultural education is concerned with improving methods of making that knowledge available to people in rural areas. The rapid adjustments required of rural people to cope with modern problems brought on by rapidly changing technology makes education more important than ever. In order to enjoy the fruits of research and increased productivity, agricultural gains must be translated into better living through education.

Study Effect of Safety Educational Campaigns

National studies have shown that farming is the third most dangerous occupation, ranking behind mining and construction work. Because this is true, educational campaigns on safety have been encouraged through various organizations, and particularly by the Maryland Safety Committee.

A 2 year study has been completed, measuring the effectiveness of safety campaigns carried on under the direction of teachers of vocational agriculture. Farm accidents were studied on 680 farms in 9 communities where safety campaigns were conducted, and on 589 farms in 12 communities where no safety campaigns were conducted.

The results clearly indicate that educational safety campaigns do reduce accidents. On farms in communities where no campaigns were conducted, there were six times as many accidents, three times as many people killed and four times as many people injured, as on farms in communities where safety campaigns were conducted.

Farm machinery was involved in over half the farm accidents, and 40% of the accidents actually occurred in farm fields. The tractor was the main culprit, being involved in 29% of the cases. The next most dangerous spot was in the barn where 17% of the accidents happened.

An attempt was made to find the causes of farm accidents. But the causes were so varied as to have little significance, except for the fact that "carelessness" was mentioned in 20% of the cases. It was also evident that a disproportionate share of accidents happen to farm youth. Forty percent of the personal injuries were to boys between the ages of 10 and 20 years.

How much carry-over value into future years the safety campaigns may have is problematical. However, it is interesting to note that teachers involved in the campaigns indicated that they felt "changed attitudes" was the most important outcome of the campaigns. *(Project T-4)*

Survey Ways to Improve Community Shows and Exhibits

Community shows and exhibits of farm and home products are rather numerous in Maryland. Such shows and exhibits are generally sponsored by local organizations such as Future Farmers of America, high school home economcs departments, 4-H clubs, local Granges and others.

In some cases they are called fairs although they should not be confused with the more extensive county and state fairs. The importance of these small shows and exhibits is attested by the rather large amount of public funds which support them.

The agriculture education department has initiated a study to (1) determine the present nature, sponsorship and extent of these shows; (2) to determine their educational value; (3) to discover difficulties involved and possible remedies; (4) to suggest ways they can be improved.

During the coming year most of the shows will be visited by a member of the agricultural education department. Information about the shows will be collected by observations, and by questions addressed to exhibitors, judges, show officials and lay people attending the shows.

Agencies cooperating in the study are the Maryland State Fair Board, Maryland State Department of Education, the University of Maryland Extension Service and local groups sponsoring the shows. *(Project T-5)*

AGRICULTURAL ENGINEERING

The project reports which follow show the scope of research in which the Department has primary responsibility. In addition, the departmental staff serves as consultants to other departments in regard to research equipment needs. Commercial equipment often is modified in the Department's machine shop to meet research requirements of other departments. Frequently, when research equipment is not commercially available, it is designed and constructed in the Department.

Tobacco Housing Studies Continued

Studies were continued towards determination of the optimum environment for curing Maryland tobacco. Tests were conducted at a constant temperature of 60°F. with relative humidities of 90%, 80%, 70%, and 60%. A check was maintained at 80°F. and 80% relative humidity. It was found, regardless of humidity, that 60°F. was to low to produce a desirable cure of Maryland tobacco. The 90% humidity gave a coarse, dark chocolate colored leaf, while the three lower humidities produced heavier, light colored leaves in the center of the plant and greenish leaves in the top—neither condition undesirable for Maryland type tobacco.

Duration of burn test indicated excellent burn for the high humidity cure. This excellent rating can be attributed to "house burn" which has been found to be associated with good burn. The check treatment also gave a desirable burn, accompanied by a good yield and value per pound.

Studies were conducted on loss of dry matter in the tobacco plant during curing for the 1957 and 1958 crops. The dry matter content of a fresh cut plant averaged 14.2% of its green weight. The dry matter in the leaf averaged 14.4%; the stalk 0.60% less. The dry matter content of the cured plants averaged 11.1% or original green weight, with little or no differences between treatments. On this basis there was a 3.1% loss of dry matter in the plant during curing. However, when the leaves and stalks were analyzed separately the average dry matter in the leaf was 9.4% and in the stalk 14.8%. This indicated a loss of 4.8% in the leaves and a gain of dry weight in the stalk. It is thought that this was due to a movement of plant food from the leaf to the stalk during curing. To determine the green weight of leaves in the cured plants, a regression line of green leaf weight to green plant weight was fitted for the 1957 and 1958 crop samples. It was found that samples of both years could be fitted to one line. The final equation was Yi = 48.607 + 0.6370 Xi. Yi is equal to the weight of the green leaves, Xi is equal to the weight of the green plant.

Preliminary studies were conducted on controlling the temperature and humidity conditions during curing in a standard size barn. Very satisfactory results were obtained, indicating that Maryland tobacco can be barn-cured under controlled conditions. The system used oil burners to provide heat, and humidity was provided by a surface type humidifier made by blowing air through a wet excelsior pad. Air was recirculated constantly with fans to keep uniform conditions in the barn. The humidifier was controlled by a humidistat while the wickless oil burners were controlled manually.

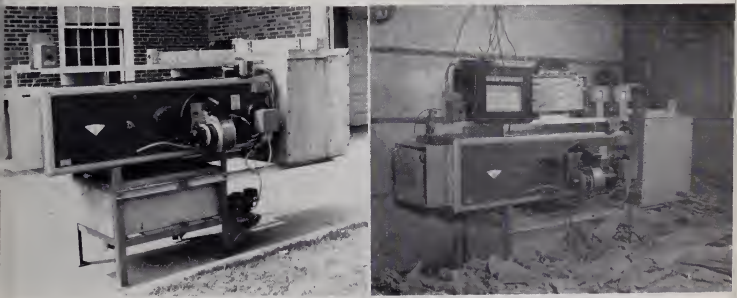
(R-11-d)

Stripping Room Humidifier Developed

Samples of tobacco from the 1956, 1957 and 1958 crop cured under different controlled environmental conditions were exposed to a range of constant temperature and humidity conditions until equilibrium was reached. Moisture content and handling condition were determined. Results show that for good handling of Maryland tobacco the moisture content should be between 19 and 24%. The tobacco can be handled several percent below this range. However, care must be taken to prevent damage due to breaking.

The equilibrium moisture content of the "house burn" samples were lower than for the other samples. There was no marked difference in the moisture content of the other treatment samples. The moisture content varied consistently for the 3 different years, with the 1956 crop being the higher and the 1957 crop the lowest of the three. This was true for all conditions tested. When separating the plants into 4 farmer grades it was found the moisture content of the bottom leaves (seconds) were much lower than the top leaves (dulls). There would be an average difference of from 4 to 6%, depending on the humidity condition tested.

Previous studies of the environmental requirements found 66°F. and 80% relative humidity desirable, both for men working in a tobacco stripping room and for the tobacco to remain in a moisture condition favorable for handling. A stripping room conditioner capable of producing these desired environmental conditions in a conventional tobacco stripping room was designed, constructed and tested. The unit did an outstanding job of producing the desired conditions. This unit consisted of a 84,000 BTU automatic warm air furnace and a surface type humidifier. The surface humidifier used a 2-inch thick excelsior pad size 30- x 40-inch which was kept wet by a small pump recirculating water from a tank under the unit. The furnace was



Left: The tobacco stripping room conditioner as installed at the Tobacco Research Farm. Recorders, water gages, and clocks are for collection of research data. Right: The conditioner as it would be used on a farm. Air passing through the unit is filtered, heated, and humidified to maintain optimum conditions for stripping.

controlled by a room thermostat and the humidifier by an electronic humidity controller.

The tobacco stripping room used was 30- x 28.5- x 9.6-feet and of cinder block construction. To prevent condensation 4 inches of rock wool was used in the ceiling.

During 50 days of operation the furnace operated 31% of the time, burning a total of 303 gallons of number 2 fuel oil. The average daily operation cost was about $1.00 per day. The humidifier operated 15.8% of the time during this period, indicating sufficient capacity for the humidifier. The outside temperature during this period ranged from 3°F. to 70°F.

Some of the advantages of this equipment are: The farmer can strip tobacco continuously during the winter months, tending to balance the seasonal work load. Tobacco can be stripped faster due to no breakage of the leaf and no time is lost in selecting a "tie" leaf. The dust problem was substantially eliminated through the use of the fiber glass filter of the furnace and the excelsior pad. This should provide a healthier place to work.

(R-11-e)

Continue to Study Chopped Forage Handling

This year's work was an extension of previous work to find the velocity of air required to float partially cured chopped hay, the quantity of hay a given volume of air will deliver, and methods of obtaining a uniform flow of material into an air stream.

The high speed conveyor used to introduce partially cured chopped hay into the air stream was rebuilt so that the discharge of the conveyor would be closer to the outlet of the fan, providing air to move hay through 100 feet of horizontal 14-inch diameter pipe. At the point of delivery of air into the section where the hay is discharged from the conveyor, an orifice with an area equal to 0.35 of the cross-sectional area of the pipe was installed. The purpose of the orifice was to change static pressure to velocity pressure, thus reducing the back pressure on the feed conveyor. This in turn reduced the "blow-back" of hay.

A 2000 in.-lb. torque meter and a generator tachometer were installed to

Equipment used in research on pneumatic handling of chopped forage.

determine the horsepower required to drive the fan used for air supply. Four SR-4 load cells and an indicator were installed to determine the rate material was being delivered to the receiving box.

The maximum rate obtained for a full 5- to 6-minute test, using hay with 45.6% moisture content, was 9.2 tons per hour. The peak 1-minute rate for the same moisture content hay was 10.5 tons per hour.

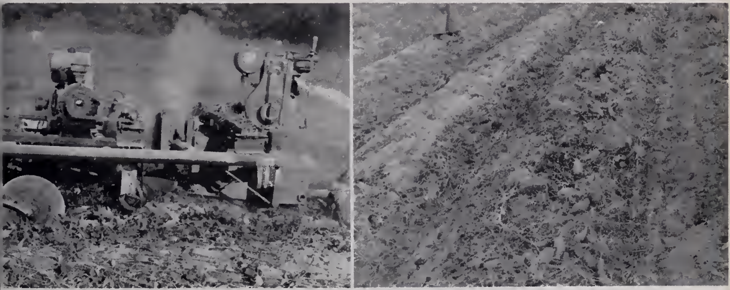
The unit worked reasonably well, but in order to be able to collect data that can be properly analyzed the feeding system will need to be improved so that a more uniform delivery of hay can be maintained. *(Project R-16)*

Sweet Potato Harvesting Machine Designed, Built and Tested

Work on harvesting sweet potatoes was continued with a new machine designed and built by the department to remove vines, to allow digging with a conventional potato digger.

This machine consisted of three units, a pair of rolling coulters to cut the vines on both sides of the row, a pair of receding finger rolls to gather the vines over the row and a unit from the 1957 machine to tear the vines from the plants and chop or tear them fine enough to permit digging.

This machine was effective in removing a heavy growth of vines under weedy conditions but the rate of travel was slow, due to lack of power to the receding finger rolls and lack of capacity in the chopper unit. Digging, under almost ideal ground conditions, was quite satisfactory with very little bruising of the potatoes. *(Project R-18)*



Left: The machine used in 1958 to remove sweet potato vines before digging. Right: The sweet potato field after vines were removed. Left side before digging, center as dug, and right side after harvest.

AGRONOMY

Development of improved varieties and better crop and soil management practices are the goal of the research program in agronomy. The size and importance of the task is emphasized by the many crops and the wide variety of soils in Maryland.

To effectively cope with the many problems in this field a balanced program of basic and applied research is essential. The former provides information necessary for continued, long-time scientific progress. The latter takes the building blocks molded from basic research and constructs the answers to immdeiate problems.

Increased production efficiency is emphasized throughout the program of research. Both the fundamental and applied phases are geared to lowering costs of production.

Hood Soybeans Released to Maryland Farmers

Hood, a new soybean variety of Group VI maturity, was released by the U.S.D.A. and cooperating State Experiment Stations, including Maryland, on July 15, 1958. This variety is a few days earlier in maturity than Ogden, exhibits a yellow coat with a light brown hilum, and is superior to Ogden in seed quality, oil content of seed, resistance to shattering, and disease resistance.

Continuous testing of new strains of soybeans from current breeding programs is important to the Maryland farmer. It insures him of a knowledge of their adaptation and performance prior to their formal release as varieties. Plans for the increase and release of two more varieties, one of Group IV maturity and one of Group V maturity, are in progress. *(Project B-43)*

More High Quality Alfalfa Hay with Good Management

Alfalfa continues to play an important role in the forage picture of Maryland. The question of how early alfalfa can be cut in the spring without serious damage to the stand has not been completely answered. However, results obtained over the past 4 years indicate that this crop can be cut much earlier in the spring than was once believed—without damaging the stand.

Irrigation practices have been studied intensively for the past 4 years.

During the past 4 years, alfalfa plots cut at full bud (just prior to bloom) at the first harvest have been as productive as plots cut at 1/10 bloom. The forage quality has been considerably higher. Stands are still as good on the full bud cut as on the later cuttings. When the first harvest has been made earlier than full bud, yields and stands have been reduced. In all of these treatments the second and third cuttings have been made between 1/10 and 1/2 bloom.

On plots where a fourth harvest has been made, yields have been higher 3 out of the 4 years tested, and stands have not been noticeably reduced by this practice. When this fourth harvest is taken, it appears best to make it during early October, just prior to the first killing frost.

In plots where orchardgrass has been grown with alfalfa, the above cutting treatments have tended to reduce stands more than when these same varieties were seeded alone.

(Project B-56-n)

Good Forage Stands Essential

The most productive forage stands do not occur naturally. They must be seeded. Without a good stand, profitable forage production is impossible.

Since 1954, cooperative studies with the U.S.D.A. Agricultural Engineering Research Division have been conducted in order to learn more about the problems of forage establishment and the management of these stands.

Band seeding was found to be superior to broadcast seeding 1 out of 4 years tested and fully as satisfactory in the other 3 years. This superiority was measured not only in better forage stands but in higher yields the year following seeding.

The greatest advantage of band seeding appears to be where conditions are unfavorable for establishment.

Under conditions of higher fertility, high pH and adequate moisture, band seeding appears to be no better than broadcast seeding provided the seedings are made on time. Band seeding does provide more flexibility in seeding dates and takes some of the gamble out of forage establishment.

Good seedling year management is a must if satisfactory forage stands are to be obtained. Research work has demonstrated that where weeds are not a problem, better forage stands are obtained from spring seedings when seeded without a small grain companion crop. Early competition from the companion crop was often as great as, or greater than, that from weeds. In areas where spring weeds are a problem, a companion crop should be used. Or one to three clippings should be made during the establishment year. In general, alfalfa and trefoil stands were best where weeds were not present or when only one late clipping was made during the year of establishment .Ladino clover-orchard stands were often best where more than one clipping was made to control weds.

(Project B-56-m)

Irrigation and Fertilization of Forages Studied

Studies were initiated in 1958 to determine responses of forages to different rates of irrigation and fertilization. Pure stands of alfalfa and Ladino clover were grown with 500, 1000, and 1500 lbs. per acre of 0-15-30 fertilizer, and pure stands of Kentucky bluegrass, tall fescue and Midland Bermudagrass were grown with 100, 200 and 400 lbs. of nitrogen plus 1000 lbs. of an 0-15-30 per acre. Each of these forage species was grown under three levels of soil moisture.

Rainfall was near optimum during most of 1958 with the result that only small increases were obtained from the application of supplemental irrigation. During this first year, no yield increases were obtained for either alfalfa or Ladino as a result of fertilizer applications. Large increases were obtained from the three grasses by the addition of each increment of nitrogen. These studies will be continued with more emphasis being placed on soil moisture relationships with regard to forage production. *(Project BQ-83)*

Potassium Chloride Fertilizer Reduces Corn Stalk Rot

Potassium chloride (muriate of potash) apparently is a more suitable carrier of potassium than potassium sulfate—at least in fertilizing corn where a stalk rot problem is anticipated. Farmers in certain sections of the Maryland Eastern Shore have suffered high corn yield losses due to serious infections of stalk rot. The severity of this disease is thought to be related to the nutritional status of the soil and the host plants.

Various fertilizer treatments were applied to corn in an attempt to evaluate the effects of chloride and potassium on stalk rot incidence. Plots receiving potassium chloride yielded 11% more standing corn that did those receiving potassium sulfate. Potassium chloride produced plants with 15% less stalk rot infestation than did potassium sulfate. *(Project O-58)*

Split Applications of Nitrogen Best For Bluegrass

Single and split applications of various rates of four nitrogen sources were made on established bluegrass sod in 1958. When yields resulting from single early spring applications of 80 or 160 pounds of N were compared, urea gave greater yield increases than did ureaform, $(NH_4)_2SO_4$, or NH_4NO_3. However, when yields from split applications of nitrogen (one-half in early spring and one-half after the first cutting) were compared, those where NH_4NO_3 was applied were the highest. In general, split applications increased yield more than single nitrogen topdressings.

The highest percent recoveries of nitrogen by the bluegrass from ureaform, $(NH_4)_2SO_4$, and NH_4NO_3 were 32, 38, and 57%, respectively, at 320 pounds of N per acre in split applications. The highest nitrogen recovery from urea was 56% at the single 80 pounds of N per acre topdressing. However, plant recovery of nitrogen from urea was relatively high at all rates and types of application. *(Project O-61)*

Best Time to Apply Potassium Differ For Alfalfa and Alfalfa-Grass Mixtures

Results of the first year of a continuing experiment indicate that the optimum time of potassium application may be different for alfalfa than for an alfalfa-orchardgrass mixture. In the case of alfalfa alone, greatest dry matter yields were obtained at all rates of potassium when applied after the first cutting. Highest yields of alfalfa were obtained at the 200 pounds of K_2O per acre rate (potassium applications ranged from 0 to 400 pounds of K_2O per acre).

In general, alfalfa-orchardgrass yields

exceeded those for alfalfa alone. Yields of the legume-grass association were usually highest when potassium was applied in early spring or just after the first cutting. It is interesting to note that, in contrast to the yield data for the alfalfa-orchardgrass mixture, the yields of alfalfa were lowest when potassium was applied in the early spring. *(Project O-60)*

New Pasture Combination Recommended

Forage needs have steadily increased with larger numbers of cattle in Maryland. Recent experimental work has shown that these needs may be more completely met in much of the Coastal Plain area of the state by the use of Midland Bermudagrass overseeded with rye. This is a new concept in pasture production in Maryland. Never before have such large beef gains per acre been obtained from any experimental pasture. Midland Bermudagrass overseeded with rye produced 750 lbs. of beef per acre in 1958. The next highest producing pasture was reed canarygrass with 432 lbs. of beef per acre. This is the second year in which over 700 lbs. of beef per acre has heen produced on the Midland-rye combination.

Midland is a vigorous perennial that produces an abundance of forage during the hot summer months when most cool-season species are making very little growth. The overseeded rye furnishes an abundance of pasture during early spring and late fall when Midland makes very little growth. Thus, in the Coastal Plain area this combination can furnish at least 8 to 9 months of continuous grazing compared with 6 to 7 months with cool-season pasture mixtures such as orchardgrass-Ladino clover.

Since the rye is seeded directly into the tight Midland sod, grazing during wet conditions is not hampered by soft, boggy turf as is often the case when rye is planted in a prepared seedbed or when sudangrass is used for summer grazing. *(Project B-56-j)*

Variety Tests Reveal Superior Forages

Variety tests at College Park and Trappe, involving sudangrasses and millets, disclosed a great diversity among varieties in regard to yielding ability, aftermath production, date of flowering, plant height and stalk diameter, resistance to leaf diseases, and leafiness. Gahi-1 pearl millet appeared

Early spring growth of rye overseeded in a Midland Bermudagrass pasture. Left: Just prior to being grazed. Right: Immediately following grazing. Midland is dormant at this time of year. Note the small crimson clover plants in foreground above.

to be especially promising. Several new sudangrasses were superior to Tift and Piper in disease resistance.

Chesapeake continued to demonstrate its superiority among red clovers, especially in seedling stands during 1958. Yield performance of DuPuits alfalfa at College Park for a five-year period, 1954-1958, was highest of all varieties. All recommended varieties (DuPuits, Narragansett, Williamsburg, Atlantic, and Buffalo) yielded well in this experiment. Ladino clovers exhibited a general lack of persistence. Midland Bermudagrass excelled in forage yield and winter hardiness at three locations in the Coastal Plain area of Maryland. *(Project B-56-1)*

Trueness-to-Type Tests Underway

Evaluation of varietal purity of various forage seed lots offered for sale in Maryland was begun in 1957. Results with most of the lots tested to date indicate that they are quite similar to the check lots and that farmers who planted them could expect results equal to the name varieties.

Improved methods of determining true varietal character expression are needed. This has become one of the primary objectives of this project.

(Project B-72)

Hybridization Improves Grain Sorghums

Following preliminary observations in 1956 and 1957, dwarf type grain sorghum hybrids and varieties were compared with a representative corn hybrid on two soil types near College Park.

In the good corn season of 1958, the better sorghum hybrids produced 95 to 105 bushels per acre; the sorghum varieties, 62 to 80 bushels; and the corn, 114 bushels. In this year of ample rainfall there was little difference in response on the two soil types—silt loam and sandy loam.

During the dry summer of 1957 several sorghum hybrids out-yielded corn.

Observations to date suggest that sorghum hybrids on the average will not be as productive as the better corn hybrids, but may find limited use in Maryland. *(Project B-71)*

Dwarf Corn Nearly as Productive as Normal Type

A dwarf version of Pa. hybrid 602 was compared in two tests with normal Pa. 602. Dwarf 602 was about two feet shorter than normal 602 and slightly less productive. The leafiness and sturdiness of the dwarf version were noteworthy. Provided other desirable characteristics can be retained, shorter fodder and better standing ability seems desirable to many corn growers. Corn breeders are working toward this end.

The season of 1958 was exceptionally favorable for corn in evaluation tests as well as in Maryland generally. The estimated average state yield of 62 bushels per acre set an all-time record. Test yields were recorded up to 145 bushels per acre. The crop was sound and there was very little root lodging. Four regional double-cross tests included collectively 80 different hybrids. Useful data were recorded for relative productivity moisture content and stalk breakage. These data were reported in Misc. Pub. No. 354.

(Project B-50)

Search for Effective Methods of Weed Control

In the past year work was continued in an effort to find the most effective and economical methods of controlling weeds in corn, soybeans, forages, and turf areas.

The pre-plowing treatment for Johnson grass control developed under this project is now recommended in Maryland.

In addition, several new herbicides have been tested and are now being recommended. These include Silvex for lawn chickweed control, disodium methyl arsonate for lawn crabgrass control, Simazine for annual grass and broadleaved weed control in corn, Dalapon for Johnsongrass and Bermudagrass control, Randox for annual grass control in corn and soybeans, and Amitrol for control of poison ivy, Canada thistle and milkweed.

A new method of using Dinitro for post-emergence weed control in soybeans was also successfully tested.

Some experimental herbicides including EPTC, chlordane, 2,4-DB and Atrazine show promise in the tests carried out under this project. Work is continuing with them. On the other hand, at least 20 different named or numbered experimental compounds were tested and found not to be suitable for use in agronomic crop and turf areas in Maryland.

Several treatments (including 2,4-D) have been tried post-emergence on soybeans, but to date none have looked satisfactory.

Work has been started with granular herbicides such as EPTC. These appear to be very promising, particularly in alfalfa and in soybeans.

Work has also continued on several weed problems peculiar to certain areas, such as nimblewill and German knotgrass. Dinitro and CIPC show some promise in controlling them but are not the final answer as yet.

(Project B-58-e)

Basic Studies Begun on Foxtail Control

One of the major weed problems in corn in Maryland is the annual grass known as "foxtail." With the successful use of 2,4-D to control broadleaved weeds, the grasses have become more prominent.

Actually "foxtail" in Maryland usually means 2 species; Giant foxtail (*Setaria Faberii*) or Yellow foxtail (*S. lutescens*). Since it is best to know in detail the life cycle of a plant in order to most economically and efficiently control it, a detailed study of these two foxtails is underway.

Seeds of giant foxtail were found to have a primary dormancy period. Various combinations of treatments, including alternating temperature and light conditions, warm moist storage, and treatment with 2% potassium nitrate did not break this dormancy. Cold (42°F.), moist storage for at least 2 weeks did break it. Yellow foxtail did not have this same dormant period.

The growth characteristics of the 2 species were also studied. Both species began to tiller about 18 days after plant emergence. Yellow foxtail plants produced as many as 147 tillers. Giant foxtail produced a maximum of 34 tillers. Heads emerged in both species about 45 days after germination.

Giant foxtail pollination occurred about 10 days after the head emerged from the boot. About 20 days after head emergence, the seed was in the milk stage, and was hard after 31 days. Seed collected up to 17 days after head emergence was not mature enough to be viable. Seed collected from 20 to 34 days after head emergence was stored and was viable. The best germination occurred with seed that was harvested 31 days after head emergence.

(Project B-70)

Changing Weather Reduces Soil Aggregation

Soil aggregates from three different soils that were frozen rapidly and slowly in the laboratory were reduced 68% in soil aggregate stability. Wetting and drying also reduced the soil stability but its effect was not quite so large. Stability was measured by determining the resistance of soil aggregates to slaking when immersed in water.

Since low aggregate stability is associated with soils in poor physical condition that are subject to crusting and are difficult to till it is evident that farmers should attempt to reduce freezing and thawing of soils in good physical condition.

Freezing and thawing after plowing has often been used by farmers to improve the workability of soils in poor tilth but unfortunately this appears to be only a temporary improvement and should not be used on soils in good tilth where the reduction in aggregate stability will be harmful.

(Project O-56)

New Soil Test Methods Look Promising

Through the years soil chemists have developed many tests to determine the potassium fertility of a soil. One of the best of this group of tests is the ammonium acetate method which has been shown in many instances to extract a quantity of potassium from the soil that is closely related to that which the plant can obtain. This is the situation for a single crop.

Studies involving this test and two crops of sudan grass and two crops of alfalfa indicate that the test also is related ($r = 0.85$) to the total amount of potassium removed by these successive crops. The study involved 25 Maryland soils.

This work was suggested by a study of a thermal method for determining potassium which was in progress at the time. The thermal method which looked promising failed to live up to its expectations in that it did not correlate well with the potassium removed by the two crops of sudan grass and alfalfa. The thermal method was based on the assumption that potassium is released from clays in a constant negative progression of like logarithmic rates. The present study showed these rates to be variable.

A revision was suggested for the thermal method because of this error. This revision has been used by other laboratories, since it improves the thermal method somewhat.

Additional correlation work has been started on the E.D.T.A. limestone test that originated in this laboratory. This method has been suggested as a possible state control test for determining the efficiencies of limestones.

(Project O-55)

More Information Available on Alfalfa Fertilization

Alfalfa often yellows in Maryland fields in the months of July and August. For many years before this project got under way the cause of this yellowing was thought to be leaf hopper injury. Now, it is known that, in many instances, this may not be the only reason for this malady, since the lack of sufficient boron also results in yellow alfalfa. Actually, both leaf hopper injury and boron deficiency frequently occur in the same field. It is recommended that 15 to 30 lbs. of borax be applied to alfalfa stands annually.

Other studies on boron analysis of alfalfa showed that it was often impossible to tell by plant tests in the spring whether an alfalfa plant would have sufficient boron for the rest of the season. This was because the soil's supply of boron to the plant was varied by soil moisture.

When fertilizer ratios were studied for this crop it was found that an 0-10-30 was the best fertilizer for the alfalfa on Beltsville soil. Beltsville is a coastal plain soil that has many characteristics of the soils found on the Eastern Shore and in Southern Maryland. At present 800 lbs. per acre every year seems to be the optimum amount. Yields of 6 tons per acre have been obtained with this fertilization.

(Project O-51)

Soil Mineralogy Studies Help Evaluate Maryland Soils

Soil mineralogical studies of the past 6 years have provided valuable information on soil genesis and soil management. In addition, helpful criteria were developed for soil classification as a result of clay mineral knowledge. Soils of the lower Piedmont and upper Coastal plain have polygenetic features due to surficial deposits transported either by water or wind. These more recent sediments contribute to the youthful nature of the topsoils. Ancient erosion surfaces form many of the subsoils, appearing either as hardpans or very firm horizons. Subsoil farming, as a result of erosion, presents many problems, the most common being root penetration, fertilizer loss and droughtiness.

Our most fertile and valuable soils are residual soils in the upper Piedmont and lower Coastal plain. The fundamental reason for this is that in the first case the soils were formed under normal topography and geological erosion from parent rocks geochemically well-balanced. On the lower coastal plain soils were formed on young Pleistocene marine and brackish water terraces where primary and clay minerals are well diversified. The presence of illite and vermiculite in these soils enhance their productivity.

Soils of the Appalachian region are more complex, since they have developed on several extreme varieties of sedimentary rocks. Those formed on shale and sandstone are naturally low in fertility. In addition the pedimented areas have claypan and fragipan problems. Studies made in the nature of the fragipan in Cookport soils so far have explained some of the processes responsible for its impermeability, induration and scattered occurrence.

Further mineralogical studies will be concerned with completing clay mineral characterization and attempting to isolate or segregate certain clay mineral species of Maryland soils.

(Project O-54)

Soil Correlation Studies Show Need for Geomorphic Investigations

During the past six years final soil correlation studies were made of Montgomery, Frederick, Washington and Caroline counties. The soil survey report and map of Frederick County have undergone final editing and the publication will appear early in 1960. The report and map of Montgomery

County are now being edited by Soil Conservation Service and University of Maryland soil scientists.

Preliminary soil correlation and classification studies were made in Allegany, Garrett, Howard, Cecil, Queen Anne's, Wicomico, Prince George's and Charles counties. Some 100 soil morphological descriptions were made and 50 monoliths were constructed.

The most serious soil classification problems encountered were concerned with identification of parent material in polygenetic soils, estimating the relative contributions of superimposed surficial deposits in profile differentiation and correlating Maryland coastal plain soils with those south of the Potomac river.

Geological maps published so far indicate deep-seated rock formations and sediments but do not contend with superficial deposits from which most soils are derived. Investigations made so far indicate that these surficial deposits have a great variety of sources. Many are eolian sediments, marine terrace or fluvial alluvium and glaciomarine from stranded icebergs. Others are pediments, erosion surfaces or ancient river terraces. In order to make a rational soil classification on such diversified materials, a systematic identification and mapping of these geomorphic formations will be necessary. Such studies are being planned for the near future. *(Project O-48)*

Short Rotations Best for Tobacco

A 3-year rotation study, in which tobacco was followed by different grass and legume combinations, has been in progress since 1952. The longer rotations have produced lower yields and dollar values than tobacco grown every year with winter cover crops. Among the various 3-year rotations, no real differences existed. *(Project B-68)*

Irrigation of Tobacco Helpful in Dry Years

The use of irrigation in 1957 led to high quality in the tobacco crop, as well as low nicotine content and somewhat reduced total nitrogen content. No supplemental irrigation was needed for tobacco in 1958, as rainfall was adequate to excessive during July and August. *(Project BQ-83)*

Tobacco farmers at an Experimental Field Day saw how tobacco dollars can be increased by higher levels of fertility, irrigation, variety and cultural practices.

Climatological Studies Continuing

Further progress in climatological studies have included the transfer to key punch cards of weather data from 44 long-time weather stations in Maryland—about half a million cards in all. Stations meeting requirements for inclusion in a Climatic Atlas of the Northeastern States are being analyzed. More detailed use of the weather data from limited areas will follow.

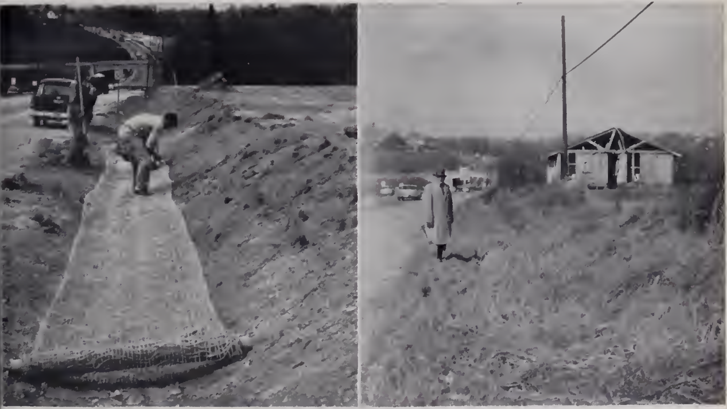
Measurements of the energy received from the sun have been more intensively studied. The relation of incident radiation to growth and the water budget is being analyzed by electronic computer. *(BOQR-84)*

Jute Thatching Useful for Temporary Erosion Control

Field trials made in Maryland in 1958 indicate the usefulness of jute thatching as a temporary erosion control measure on critical areas while grass seedings or other newly planted vegetation are developing erosion resistance. These are cooperative studies with the U.S.D.A. Agricultural Research Service and the Soil Conservation Service.

Jute thatching is a coarse, open-mesh, web-like material woven of heavy jute twine. Its tensile strength and bulk adapt it for use as a temporary protective surfacing where soil cutting by flowing water or wave action is expected. It also serves as a wind-resistant mulch that produces at the ground surface a favorable microclimate for seed germination and seedling growth. In connection with grass seedings, or the transplanting of sprigs of grasses like Reed Canarygrass or Midland Bermuda, the thatching may be used instead of a more expensive sodding operation. The thatching costs about 20 cents per square yard.

Tests have been made of jute thatching for erosion control in farm water-



Jute thatching has been shown to be useful temporary erosion control. Left: Laying thatching in a roadside in Prince George's County. Right: The same ditch after seeded grass had grown through the thatching.

ways and roadside ditches, on overfalls and along waterfronts. A high degree of successful control was obtained throughout the tests.

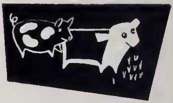
In using the thatching, the eroding area is shaped, graded, and fertilized in a conventional manner. It is best to lay the thatching on loose ground so that later compaction presses it into the soil to prevent a flow of water beneath it.

Strips of the thatching are overlapped where ends or edges meet. Ends at the top of the strips are buried in a trench to a depth of 4 or more inches. Along the edges and centers of the strips wire staples 6 to 12 inches long are used at 4 to 10 foot intervals to peg down the strips. If wooden pegs were used, they might catch trash and divert runoff water out of the thatch-protected channel, if they extend above the thatching.

Thatching with a ¾-inch mesh was used on the shore erosion tests. Thatching with a 1-inch mesh appeared as suitable as the closer woven material for erosion control in waterways.

Although the thatching ultimately decays, it retains much of its tensile strength and erosion resistance for several months, thus giving plenty of time for grasses to take over.

ANIMAL HUSBANDRY



The research program of the Department of Animal Husbandry has expanded during the past 10 years by the addition of projects in new areas of study. This has been possible because of the interests of new staff members and because of intimate cooperation with other departments of the University such as: Dairy, Bacteriology, Veterinary Science, and Agronomy and with certain outside agencies: Livestock producers, United States Department of Agriculture, and commercial concerns.

A well balanced research program has been created which includes work on beef cattle, sheep, and swine. Some projects are designed to attack 'basic', or 'fundamental' problems and the results of this research are published in technical journals or bulletins. This type of work lays a foundation for the eventual solving of problems of an applied nature. The other projects deal with more immediate problems of a so-called 'practical' type. Irrespective of whether or not the projects are of a 'basic' or 'practical' nature, research workers convey, by various means, the results to producers as soon as reasonably possible, very frequently with the close cooperation of extension specialists. The Maryland Beef Cattle Improvement Program is an example of a rather rapid application of results obtained from 'basic' research wherein research workers cooperated closely with extension specialists in getting 'basic' research results working on the farm.

Magnesium Content of Forage Implicated in Winter Tetany

During the winter of 1957 - 58, magnesium tetany developed in beef cows in the University herd that were fed mixed hays from Garrett County farms on which a high incidence of tetany occurred. Dairy cows fed such hays did not develop symptoms of tetany. Blood serum magnesium levels were extremely low, at the time of calving, in both beef and dairy cows. Magnesium as percent of the bone ash, in 5 samples obtained from beef cows by biopsy, ranged from .08 to .71 as compared to an expected normal of 1 - 1.2%. Thus, it would appear that bone magnesium had been depleted during the period when the Garrett County hays were fed. Blood levels of calcium, potassium and sodium were in the normal range.

The hays fed to the experimental animals were 1956 crop forages and magnesium content of the hays ranged from .067% to .115%. 1957 crop hays from the same farms contained 2 - 2.5 times as much magnesium as did the 1956 crops. The incidence of winter tetany in beef cows on these farms was quite low in the winter of 1957 - 58 when the 1957 crop forages were fed. The low magnesium content of the 1956 hays was at least partially responsible for the tetany which developed when the hays were fed.

The 1956 crop hays were late-cut, weather-damaged forages while the 1957 hay was of much higher quality and contained more legumes. Magnesium in plant materials decreases as the plants mature and is also liable to leaching when hays are rain-damaged during field curing. Legumes contain considerably more magnesium than do grasses. Differences in quality and legume content of the mixed hays from the 1956 and 1957 crops, presumably due to weather conditions, could account for the differences in magnesium content of the two forage crops. 1956 - 1957 was a "tetany year" in the affected area, 1957 - 58 was not.

Studies of the effect of magnesium supplementation upon cows fed tetany producing forages have been initiated. Magnesium carbonate was fed to 4 animals which had been maintained for 6 weeks on hay which produced tetany in the University herd. Results show that 30 grams per cow per day of magnesium fed as the carbonate will increase serum magnesium levels from approximately 1.0 mg. % to 2.0 mg. % in 7 days. Hay was not available for further feeding. Palatability tests indicate cattle will consume 30 grams of magnesium in oxide or carbonate mixed in 5 pounds of silage; epsom salt not palatable enough to be consumed in the desired quantities. Under conditions where magnesium tetany occurs, the only feasible recommendation that can now be made is to increase the magnesium intake of the animals. *(Project G-37)*

Systemics Useful in Ox Warble Control

It has been estimated that millions of dollars are lost each year in the United States due to ox warbles or cattle grubs (larva of heel fly). These losses are due to decreased and more expensive beef and milk production, extra carcass trimmings and "warbly" hides (before emerging from the backs of cattle the warbles cut holes in the hides). Fly repellents have not proven satisfactory. The application of insecticides applied after the warbles have cut holes in the skins of the cattles' backs, while killing most of the warbles, comes too late in the life cycle of the insect to prevent much of the damage to the host.

To test the value of new systemic insecticides (chemicals that kill the grubs internally while in their early stages of development) 30 Angus and 25 Hereford calves (used in Project C-31-a) and 6 Angus and 6 Hereford yearling heifers from the University's herds were used in a trial. The calves were divided into 6 lots on the basis of breed, age, sire and weight; there being 2 steer lots and 4 heifer lots. Half of the calves in each of the 6 lots received a systemic insecticide treatment on August 27, 1958, before weaning and while on pasture. The other half were used as controls. The systemic 0.0-Diethyl 0-(3-Chloro-4-Methyl-7-coumarinyl) phosphorothioate (Co-Ral) was administered as a .5% spray to 10 steers and 10 heifers in 4 lots, while the systemic 0.0-dimethyl 0-2.4.5-tri-Chlorophenyl Phosphorothioate (Trolene) was given as a bolus (a form of large capsule) at the rate of one bolus per 300 pounds liveweight to 8 heifers in 2 lots. Half of the yearling heifers (divided as equally as possible as to breed, age and weight) received the latter systemic in their feed starting September 8, 1958. This insecticide was mixed with 4.5 pounds of soybean oil meal to make a 10% mixture and was fed in 7 consecutive feedings, being fed twice daily.

During the trial, 5 calves infested with warbles were found in the untreated groups but none were found in the treated groups. There were no apparent ill effects from the systemics. The calves that were treated before weaning and while on pasture on August 27 had gained just as well by their September and October weigh days as the untreated calves. Neither was there any consistent difference in their gains throughout the feeding periods. The average daily gain per head from October 7 to April 21, for all the treated calves was 1.80 pounds and for the untreated calves 1.88 pounds. Apparently the degree of ox warble infestation was not great enough to affect gains.

In the yearling heifers which were just being wintered, rather than fattened as were the calves, no ox warbles were found but the average daily gains were slightly greater in the treated group. From September 6 to March 5 the average daily gains of the untreated heifers being .74 pound and of the treated heifers .89 pounds, a difference of .15 pound in favor of the treated group. This difference in gain may have been due to the effect of the systemic on internal worm parasites rather than ox warbles.

A demonstration trial was conducted, by extension personnel in cooperation with the county agent of Prince George's County, with beef cattle that were more heavily infested with ox warbles than the University's beef herds. Forty Hereford calves, 3 to 10 months old, and estimated to weigh from 250 to 600 pounds were used. On October 10, 1958 fourteen of these calves were sprayed and 14 were given boluses using the same kind of systemics that were used for the University's calves. The other 12 calves received no systemic.

The calves were checked on January 27 and March 13 for grub infestation by counting the lumps on their backs. On January 27, 2 grubs were found in the sprayed group and 39 in the untreated group. On March 13, 6 grubs were found in the group that had received the boluses and 36 in the untreated group. The number of grubs in the untreated calves varied from 0 to 13 while the highest number found in a treated calf was two. It is planned to repeat the Experiment Station trial starting in the fall of 1959.

(Project C-32)

Study Value of Pelleting Barley for Beef Calves

Recent tests at the University of Maryland have shown that the feeding value of barley for growing and fattening swine was materially improved by pelleting. Since barley makes up an important part of the feed grains produced in this area it would be most worthwhile to determine the value of pelleting it for beef cattle.

Fifty-five Angus and Hereford creep-fed calves from the University's herds were weaned and started on feeding trials on October 7, 1958. There were two lots of 11 steers each and four lots of 8 or 9 heifers each. Calves were divided into as uniform lots as possible according to breed, sire, age and weight. They averaged approximately 8 months of age. Steers averaged about 500 pounds and heifers 465 pounds in weight at the start of the trial. All groups received a ration of barley, alfalfa-grass hay and minerals full-fed and a protein supplement. The barley was crimped for one of the steer groups and two of the heifer groups while in the other three groups, it was pelleted.

From the start of the trial on October 7 to April 21, 1959 the approximate gains were 1.7 pounds per head daily for the heifers (the end of their trial) and 2.1 pounds for the steers. These gains were satisfactory, considering the calves were creep-fed prior to weaning. To date there has been no apparent advantage from pelleting the barley in rate of gain or in feed efficiency. (The average daily gain of the groups receiving crimped barley was 1.84 pounds and for those receiving pelleted barley was 1.78 pounds.) However, since the cost of pelleting the barley was $4.00 more per ton than crimping it, the cost of gains was greater in the pelleted groups.

Indications from this one trial are that pelleting barley for finishing beef calves fed the above rations would not be a profitable procedure. Plans are to repeat the test with similar calves starting in the fall of 1959.

(Project C-31-a)

Compare Soybean Oil Meal and Commercial Feed Supplement

The use of commercial feed supplement containing urea, molasses, ethyl (grain) alcohol, phosphoric acid and trace minerals (Morea) as a supplement to farm grown grains has received considerable attention among beef cattle feeders in this area. It has been used in the rations of a relatively large number of private feeding operations with apparently satisfactory results. However, its comparative feeding value with one of the standard protein supplements such as the oil meals had not been determined since no check lots were included. Cattle feeders in this area were very anxious to have this comparison made, so a test was started on October 7, 1958 using soybean oil meal in the check lots.

Thirty-three Angus and Hereford heifer calves from the University's herds were weaned and divided into four uniform groups on the basis of breed, sire, age, and weight. All lots received a ration of barley, alfalfa-grass hay and minerals. Two of the lots were fed soybean oil meal as a protein supplement at the rate of one pound to 8 pounds of barley. In the other two lots the calves had access at all times to the liquid commercial supplement in tanks.

For the 196-day feeding period, the average daily gain per head for all four groups combined was 1.7 pounds. There was no appreciable difference in gains between any of the groups. (The average for the soybean oil meal groups was 1.68 and for the commercial supplement groups 1.64.) The average consumption of barley and hay per day and per unit of gain was greater in the commercial supplement lots than in the soybean oil meal lots. Although somewhat less of the commercial supplement was consumed per unit of gain than soybean oil meal, the cost of gains was higher. With 45% soybean oil meal at $96 per ton and the supplement at $115 per ton (current prices) the cost per hundred pounds gain averaged $2.10 less in the soybean oil meal groups.

Slaughter grades taken at the close of the feeding trial and carcass grades of the 12 representative heifers slaughtered showed no apparent difference among the four lots.

From this one trial, the results indicate that the commercial supplement is worth about the same per ton as 45% soybean oil meal. It is planned to repeat this trial with similar calves starting in the fall of 1959.

(Project C-31-b)

Studies of Rumen Function Begun

Much of the current research in the nutrition of sheep and cattle consists of basic studies designed to gain more information about the functions of the bacterial population of the rumen and about the relationships between these bacteria and the host animal.

It is now well known that fermentation of feed carbohydrates in the rumen results in the formation of volatile fatty acids (acetic, propionic, butyric, valeric and some higher acids) which constitute a major source of energy for the ruminant animal.

It is also known that the diet of the animal will influence the nature of volatile acid production. For example, high roughage diets result in the production of a preponderance of acetic acid, while high concentrate diets result in a greater amount of propionic acid and less acetic acid being produced. There is evidence that propionic acid can be more efficiently utilized for energy by the host animal than can acetic acid. Thus, the rumen acids offer one explanation for the higher energy values of digestible nutrients from concentrates.

It is apparent that the amounts and kinds of acids produced in the rumen can be important and that more knowledge of rumen functions and the factors that control them is needed for the understanding and improvement of energy utilization in the ruminant.

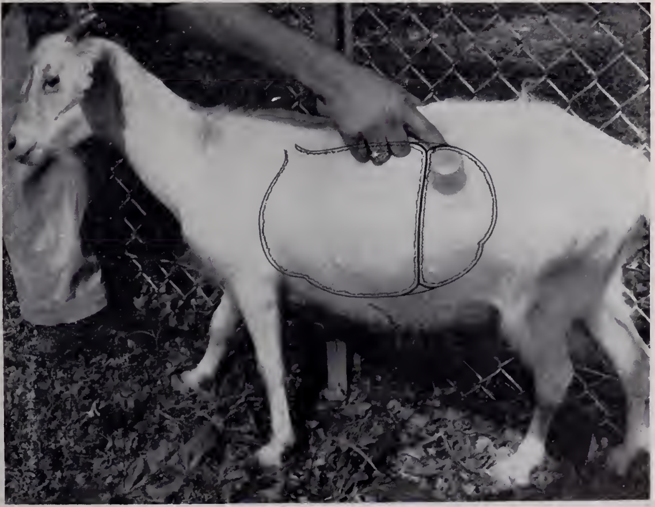
Techniques for rumen studies are being perfected and the effects of dietary factors upon the quantities and proportions of volatile acids produced are being investigated.

During the past year, a technique for establishing an isolated rumen pouch in the goat has been developed. A section of the rumen that contains representative absorptive surfaces and a normal blood and nerve supply has been isolated to form a pouch with a capacity of 1.5 - 2 quarts. This pouch is being used to study the absorption of volatile acids from the rumen. Absorption rates of individual acids appear to be directly related to concentrations of acids in the pouch. Preliminary absorption data also suggest that the isolated rumen wall can absorb acids at rates higher than calculated rates of production and that absorption, in itself, is not a limiting factor in the supply of end products of bacterial digestion to the ruminant. However, it is known that during peaks of rumen acid formation in normal ruminants (shortly after feeding) concentrations of acids in the rumen increase. This suggests that there are factors in the normal rumen which limit absorption to rates less than those observed in the isolated rumen wall. More studies are needed to determine the absorptive capacity of the rumen and the role of absorption in maintaining the rumen environment.

The isolated pouch will also be used in studies of bacterial function. It is hoped that a normal fermentation can be carried on in the pouch and that some of the abnormal conditions inevitable in "artificial rumens" or incubation flasks can be avoided.

Short-time incubations of freshly drawn rumen fluids are being used in studies of the rate and nature of volatile acid production. Results with 2-hour incubations in all-glass systems *(in vitro)* indicate that the method is valid for determining proportions of the major acids produced, and rates of production, while not as high as would be expected in the normal rumen, reflect concentrations found in the freshly drawn fluid. Since absorption also appears to be a function of concentration, it suggested that analysis of the rumen for volatile acids will give an index to quantities produced. The short-time incubation does not require elaborate equipment or sample preparation. The incubations can be conducted with relatively small quantities of rumen contents and a large number of samples can be processed at one time.

In several experiments, it was observed that the *in vitro* production of valeric and higher acids was less than would be expected from analysis of rumen fluids. The recycling or interconversion of volatile acids, one to another, was studied with radioactively labelled acetate, propionate and butyrate in rumen fluids drawn from sheep on both high roughage (80% hay, 20% barley) and low roughage (20% hay, 80% barley) diets. Recycling activity



Goat with rumen pouch, showing cannula for access to pouch. Outline of the rumen superimposed on the picture shows the approximate position of the pouch in the posterior section of the rumen.

was greatest in rumen fluids drawn from low-roughage fed animals. On either diet, most of the recycling was from acetate to butyrate or butyrate to acetate. Recycling to valeric or higher acids was not great enough to account for differences between *in vitro* production and quantities found in the rumen. From present data, it must be concluded either that low rates of *in vitro* valeric and higher acid production are artifacts or that there are conditions in the rumen which lead to some accumulation of these acids even though rates of production may be quite low.

Studies of the effect of frequency of feeding upon the rate of gain and rumen volatile acids in lambs have been conducted. Feeding 6 - 7 times per day has been compared to twice a day feeding of identical rations. Feeding at 2 hour intervals from 6:00 A.M. to 4:00 P.M. (6x/day) or from 6:00 A.M. to 6:00 P.M. (7x/day) has not resulted in any significant differences in rate of gain when compared to results obtained from giving the same daily allowance in two feeding (6:00 A.M. and 4:00 P.M.). Proportions of volatile acids in the rumen fluid were not affected by the frequency of feeding in animals fed either low roughage or high roughage diets. Studies with rumen contents drawn at 7:00 A.M. and 1:00 P.M. have shown that a 3 - 3.5 fold difference in the quantity of feed administered 1 hour prior to sampling will not necessarily affect either proportions or amounts of acids produced *in vitro*. *(Project C-25)*

Pelleted Roughages Show Value for Sheep

Studies of the value of ground, pelleted alfalfa and timothy hays for breeding ewes have been initiated. Hampshire and Southdown ewes have been fed either long alfalfa or timothy hay or pelleted alfalfa or timothy hay. Timothy hay and pellets were supplemented with .25 lb of soybean oil meal per ewe per day. Pellet consumption before lambing was restricted to the quantity consumed by the timothy pellet fed group according to breed (approximately 3.5 lb per day for Hampshire, 2.8 for Southdowns). Long hay consumption was *ad. lib.* and averages about 1 lb per ewe per day more than the pellet allowance.

Weight gains during late pregnancy have been higher for the pellet fed ewes in both breeds despite the smaller amounts of roughage required. These preliminary data indicate that either alfalfa or timothy hay pellets are worth more per pound than long alfalfa hay as a feed for ewes in late gestation. Long timothy hay, as expected, was not a satisfactory roughage for pregnant ewes as measured by weight gains and condition of the ewes.

It has long been recognized that a lack of palatability limits the usefulness of many medium and low quality roughages as feeds for sheep. Undoubtedly, much of the advantage observed for pellets in the study reported here was due to the prevention of waste of the hays fed. Pelleting offers a method of roughage preparation that will increase palatability and prevent waste.

Very little is known about the effects of ground pelleted roughages upon rumen function or the physiology of the animals. It has been reported that pelleted feeds cause changes in the mucosa of the rumen wall. Investigations of the effects of pelleting upon volatile acid production and absorption will be conducted. *(Project C-25a)*

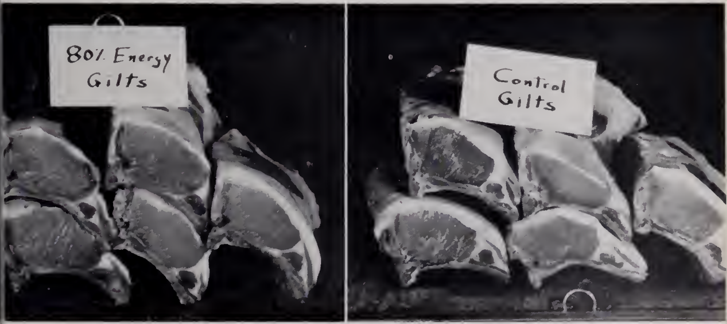
Evaluate Swine Worming Compounds

The evaluation of new worming compounds was continued during the year. Hygromycin B, piperazine dihydrochloride (Verban) mixed with feed or water and sodium fluoride were tested for their ability to control internal parasites. The only parasite detected in non-treated pigs was the large round worm. Hygromycin B added to the feed continuously or piperazine dihydrochloride administered in feed or water at 70 and 135 days of age, appeared to be effective in eliminating the large round worm. Sodium fluoride was also effective in removing the parasites, but reduced feed efficiency. Reduced feed efficiency did not accompany treatment with either Hygromycin B or piperazine dihydrochloride. *(Project C-24)*

Study Energy Needs for Economy Production of Lean Pork

Studies have been initiated to determine the effects on growth characteristics and economy of gain when swine are limited in energy intake but consume normal amounts of other nutrients. Pigs have been individually hand fed to enable more exact measurement of feed consumption and to regulate nutrient intake more accurately. All animals were slaughtered at the end of the feeding period to more accurately measure the conversion of feed to pork in terms of muscle, bone and fat.

Limited data suggest that reducing a pig's energy intake to about 80% of that consumed by full-fed animals, while maintaining equal consumption of other nutrients, increases the efficiency of nutrient utilization. Fewer pounds of feed were required per pound of gain and a higher percentage of the carcass weight was found in the lean wholesale cuts when pigs were fed rations which resulted in lower daily energy consumption. The heavier carcasses of full-fed pigs contained approximately the same amount of lean meat as the lighter carcasses from pigs fed the limited energy diet. *(Project C-26)*



There's more meat in the eye of the loin when pigs were fed restricted energy diets. Chops at left, from 80% pigs, had an average of muscle of 5.55 square inches compared with chops from full-fed pigs which had 4.75 square inches of muscle.

Added Copper in Swine Rations Studied

The growth responses of growing swine to antibiotics added to the ration are quite variable and appear to be related to the conditions under which pigs are fed. Previous trials suggested that low levels of copper added to the ration produced similar effects.

During the past year pigs were fed rations containing 10 grams of chlortetracycline (Aureomycin) and/or 0.6 pound of copper sulfate per ton. These rations were self-fed in pasture lots. A small incerase in growth rate was noted for pigs fed rations containing the antibiotic, copper or a combination of the antibiotic and copper. However, the daily feed consumption of pigs fed rations containing copper was higher and a marked decrease in feed efficiency occurred when copper alone was added to the ration. The decrease in feed efficiency did not appear when both copper and antibiotic were included in the ration.

Although some observations suggest that chlortetracycline or a combination of the antibiotic and copper are beneficial in swine rations fed in pasture lots, additional studies are necessary to determine whether or not the levels of copper used can be toxic.

(Project C-27)

Palatability of Barley Improved by Pelleting

The value of pelleted rations for swine is of interest especially when feed ingredients may be unpalatable to the pig. Comparisons have been made of the growth rate and feed efficiency that occurred when rations containing barley or corn were fed in either pellet or meal form.

Feed efficiency and growth rate were improved by pelleting the barley-containing ration. When fed until pigs reached 125 pounds, the pelleted barley-containing ration was as economical as the corn-containing ration in meal form. Charges for pelleting the barley-containing ration were compensated for in part because 10 pounds less feed were required per 100 pounds gain. In addition there was a price advantage in favor of barley over corn at the time the trial was conducted. The cost of pelleting and changes in feed efficiency cancelled this advantage when pigs weighed over 125 pounds.

The increased palatability of pelleted rations was indicated by the pigs' preference to eat pellets when given a choice between pellets and meal.

(Project C-28)

Soybean Oil Meal Tops as Free-Choice Supplement

A pig's inclination to select feeds that satisfy nutritional requirements when offered a suitable choice has stimulated investigations of the economy of free-choice feeding practices.

During the past year observations were made on feed consumption and gains in weight for groups of pigs fed either (a) a complete mixed ration, (b) a choice of shelled corn and supplement including soybean oil meal, meat and bone meal and alfalfa or (c) a choice of shelled corn and supplement containing soybean oil meal as the only supplemental protein source.

Rates of gain were very similar for all groups, but the pounds of feed required for a pound of gain were lower for pigs fed free-choice. Forty pounds less feed were required for each 100 pounds of gain when pigs were given a free choice of shelled corn and soybean oil meal supplement. Based on feed prices at the time of the trial, savings in feed costs of approximately 10% resulted from feeding pigs a free choice of protein supplement and shelled corn. The supplement with soybean oil meal as the only protein source was most economical and compared very favorably with the supplement including protein from both animal and plant sources. *(Project C-29)*

BOTANY

Research in the Department of Botany includes projects designed to yield information useful in solving immediate problems in the field, as well as projects of a more basic nature designed to yield information of the kind upon which all progress in science ultimately rests.

The scope of the research in progress in the Department of Botany is indicated by the brief reports of projects that follow.

Compile Key to Woody Plants of Maryland

The first draft of a Key to the Woody Plants of Maryland was compiled and tested on a summer class.

In the field of plant taxonomy, service to Maryland residents and extension personnel consisted of identifying many specimens of trees, shrubs, and weeds.

The University Herbarium received as a gift several thousand specimens collected by the Conference on the District Flora. Most of our effort has gone into the sorting, curating, and mounting of the Maryland specimens of this collection. These are a very valuable addition to our herbarium.

(Project F-12)

Develop New Experimental Lines, Free of Genetic Variation

Haploid plants have a single set of chromosomes. New experimental lines, free from genetic variation, have been produced by doubling the chromosome number of haploids with a colchicine treatment.

One such doubled haploid line of pepper had a strikingly high frequency of twin seedlings with haploid members. Approximately 3% of the seeds of this line produced twin seedlings. A typical set of twins was composed of a haploid and a normal member.

The high frequency line, G168A, was used in reciprocal crosses with a line characterized by a low frequency of twin seedlings in order to determine the effects of the genotypes of the male and female parents on haploidy. The two parental lines also differed in inherited fruit characters which permitted the determination of the origin of the haploids. Analysis of the cross utilizing the high frequency line as the female parent has been completed.

The pollen parent did not affect the frequency of haploids from twin seedlings. All 123 haploids classified had fruits like the female parent; thus their inheritance was obtained from the female parent only. The population from the cross utilizing the high frequency line as the male parent will be analyzed during 1959. *(Project F-15-b)*

Test Additives Stimulating Root Development

The periods of maximal rooting during the year were established for cuttings of one species in each of five genera of woody plants. Samples of the stems were collected in order to correlate cellular changes in structure with periodicity of rooting.

In order to obtain information on additives capable of stimulating root development during unfavorable periods, geranium cuttings, which root more rapidly than woody cuttings, were treated with NH_4NO_3 (basal dip in 375 ppm. for 12 hours) and Hormodin #1 (basal dip). Additional treatments were made by an aerial mist system supplying indoleacetic acid (1 ppm. for 12 hours) and a mixture of sucrose (1000 ppm.) and boron (1 ppm.) for 18 days after placement in the rooting medium.

The greatest fresh weight of roots occurred following the combined treatment of Hormodin #1, sucrose-boron and indoleacetic acid. Storage of geranium cuttings at 40° F. for 3 weeks prior to placement in the rooting medium increased the fresh root weight 2 to 5 fold in comparison with fresh cuttings receiving the same treatments. This observation suggests that depletion of carbohydrate reserve facilitates rooting. *(Project F-16)*

Organic Mercury Compounds Promise Scurf Control

During the past season, field tests for susceptibility of sweet potatoes to the scurf disease were continued. Sprouts of 26 varieties were inoculated and planted into field plots. None of the varieties was immune to infection and Maryland Golden proved to be the least susceptible, confirming results of previous, similar experiments.

Twenty-two fungicidal treatments were used as dips for sprouts produced from infected roots immediately prior to transplanting the sprouts into the field. When all aspects of the results were considered, certain organic mercurial compounds appear to offer most promise in the control of this disease. Evidence is accumulating to indicate that in light, sandy soils initial infection occurs in the plant bed rather than in the field. *(Project J-86)*

Study How Fungicides Act as Toxicants

Studies on the mechanism of action of N dodecyl guanidine acetate (cyprix) indicate that this toxicant damages the fungal membrane and other physical structures of the cell. Lethal concentrations of cyprex abolish all respiration and cause considerable loss of soluble constituents from the cells. Lethal concentrations of this fungicide also prevent uptake of phosphorous by the cells.

In contrast to cyprex, the antibiotic, actidione does not damage cell structure at growth inhibiting concentrations. Cells exposed to concentrations of this toxicant far in excess of that required for complete inhibition of growth regain their ability to grow when the antibiotic is removed. Preliminary data indicate that arginine and vitamin A metabolism of fungal cells may be disturbed by this antibiotic.

Tests in field plots indicate that growers now have considerable choice in their selection of effective organic fungicides for the control of foliage diseases of tomatoes and cucumbers.

None of the newer materials tested in 1958 was more effective than certain of the dithiocarbamates that are now in general use in Maryland.

(Project J-91)

Soil Fungicide Treatments Change Soil Flora

Treating soil with chemicals to control soil borne fungi pathogenic to certain crops may change the pH of the soil. In cost cases the pH has been increased slightly to moderately. None have been increased to where the soil is above pH 7. Most increases have ranged from pH 0.4 to 1.0 above that of the untreated soil. The soil flora, consisting of saprophytic bacteria, fungi, and algae, indicates that all fungicides lower the population of the fungi low enough to prevent competition with bacteria. As a result the bacterial population is 4-5 times the population in untreated soils.

An indirect result of chemical soil treatments for the control of fungi has been to find chemicals which have excellent algicidal properties. One such chemical has been found in soil treatments and tests show that it has a long residual control of algae and moss that grow on pots and greenhouse soil.

(Project J-93)

Constant Selection for Disease Resistance Pays Off

For the past 8 years work has been continued on the development of a tobacco variety with a high degree of resistance to the black shank disease caused by *Phytophthora parasitica* var. *nicotianae*. The first 4 years were spent in selecting for resistance and quality. In 1954 a plant was developed that had 90% resistance to black shank and good quality.

Mor 59, resistant to black shank and fusarium wilt, growing on infested soil. This is an excellent plant.

Since the start of the project some 2000 selections and tens of thousands of individual plants have been indexed for disease resistance and quality, resulting in the production of 2 varieties. Mor 59 and Mor 609A.

These varieties also have resistance to fusarium wilt. They are comparable in quality but do not have the weight of commonly grown Maryland types. The lower weight per acre is often the case with a heterogenic type of resistance which involves a number of characters that cannot be eliminated.

However, the 2 varieties developed have a higher percentage of top grades than some of the Maryland varieties. Field tests in the tobacco counties on uninfested soil show that the 2 varieties averaged 51 cents per pound for Mor 59 and 57 cents for Mor 609A as compared to Robinson, Catterton and Wilson varieties with averages of 47, 48, and 50 cents per pound, respectively.

For 3 years seed of the resistant varieties have been available for tobacco growers having black shank infested soil. *(Project J-95)*

Surveys Show Ornamentals Often Infected with Nematodes

Additional nematode surveys indicates that woody ornamentals such as rose, azalea, boxwood, and yew are often heavily infected with such plant-parasites as *Xiphinema,* dagger nematodes, *Helicotylenchus,* spiral nematodes, *Pratylenchus*, lesion nematodes, *Tylenclorhynchus,* stunt nematodes, *Meloidogyne,* root-knot nematodes, and others. Pathogenicity tests have revealed severe root injury following attack by *Xiphinema, Meloidogyne,* and *Helicotylenchus.* Control of these nematodes is now possible with 1, 2 dibromo -3- chloropropane (Nemagon, Fumazone). Experimental nematocide 18, 133 shows promise for treating infected ornamentals.

Nematodes are nearly microscopic animals so that it is necessary to observe them under a microscope to identify them. However, standard mounting methods frequently cause certain parts to become less visible. A picric acid-iodine mixture in FAA mounting medium has been of use in routine work. For more permanent staining, gold chloride has been an effective agent. *(Project J-96)*

New Respirometer Aids Study of Nematodes

A cartesian diver respirometer has been constructed which makes possible the measurement of the respiration of single nematodes. This device is 1000 times more sensitive than the Warburg respirometer. It is felt that respiration studies may indicate a correlation between metabolic activity and pathogenicity of different nematode species. Survival of nematodes under various conditions such as low oxygen tension, low temperature, drying, and under the effect of nemaatocidal compounds will be investigated. Respiration is one of the most critical measures of the effects of outside stimuli.

Certain toxic compounds are known to affect the acetylcholinesterase in killing. Finding this enzyme in plant-parasitic nematodes for the first time may reveal the mode of action of certain nematocides. Some anticholinesterase activity has been observed in the nematocidal compound extracted from asparagus.

Investigations into the effect of root-knot and stubby-root nematodes on tomato have revealed that heavy infections of root-knot nematodes cause an accumulation of N, P, K, and Na in large amounts in roots with a resultant decrease in these elements in the tops of infected plants.

(Project J-97, NE-34)

Nematodes Associated with Boxwood Decline

The survey of the boxwood decline was extended to the western shore counties, Harford County, and one nursery planting at Cumberland. Parasitic nematodes were found in every affected planting check during the year. Species identified were *Pratylenchus* sp., *Rotylenchus buxophilus, Xiphenema americanum, Trichodorus primativus, and Tylenchorhynchus* sp.

The only fungi isolated to date are unidentified species of *Fusarium*. *Phytophthora cinnamomi* was isolated from *Rhododendron*.

A greenhouse experiment designed to correlate soil drainage with the infection of boxwood by *Phytophthora cinnamomi* (the suspected casual organism) has indicated that the foliage symptoms can be duplicated by growing plants in poorly drained soil.

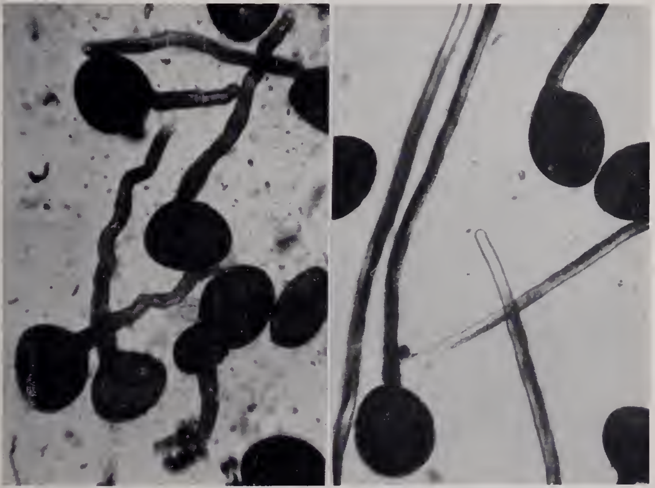
An established boxwood planting in Queen Anne's County is being used in determining the effect of fertilization and Nemagon on the boxwood decline. The planting has been divided into four plots and treated as follows: (1) 5-10-10 fertilizer only applied, (2) Nemagon 10% granular applied, (3) a 5-10-10 fertilizer — Nemagon (10% granular) mix applied, and (4) control — no fertilizers or chemicals applied.

Growth measurements are yet to be made, but visual examinations have indicated that the plots treated with 5-10-10 fertilizer or the fertilizer — Nemagon mix are overcoming the decline symptoms. Similar tests are being carried out in an established planting in Harford County. *(Project J-99)*

Gum Arabic Improves Beneficial Action of Boron for Pollen

In the absence of boron, lily pollen, *Lilium longiflorium* Thunb., may burst or have distorted pollen tubes, regardless of the presence or concentration of sucrose and gum arabic.

The most favorable medium for the germination of pollen, containing 5 to 80 ppm of boron and 5% sucrose, was vastly improved by the inclusion of 1% gum arabic.

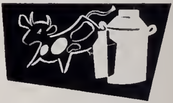


Left: Lily pollen germinated in a medium lacking boron but containing sucrose and gum arabic. Note bursting and distorted growth of most pollen tubes. Right: Apparently normal growth of lily pollen tubes in a medium boron, as well as sucrose and gum arabic.

The reason for the beneficial action of gum arabic was not definitely established. The media containing gum arabic were buffered against pronounced changes of acidity or alkalinity. This may be an important consideration for such as gum arabic, are known to reduce the availability or free energy of water. This may have prevented a too-rapid, "unregulated" absorption of water by pollen which so often results in bursting.

Other gums and pollens are being studied to determine how universal this effect may be and to elucidate the nature of this effect. Also being sought are other unidentified factors which prevent the artificial germination of pollen (i.e., *in vitro*) from approaching that which does and must occur in nature. *(Project K-8-c)*

DAIRY



Research studies on problems facing the dairy industry, associated with more efficient production of milk and the processing of dairy products to make them most useful and economical to the consumer, are included in the research program in dairy.

Information obtained from studies on factors in feeds affecting the composition of milk and efficiency of milk production and growth should prove especially useful. The hormonal control of milk secretion and the usefulness of forages for milk production have also been given special attention.

Investigation concerning the chemistry involved in the flavor of milk and its products, as well as newer methods for determining the fat content of milk, have provided information of value to the milk processing industry. The development of methods for utilizing fruit essences and concentrates in ice cream manufacture will make possible new and improved ice cream flavors.

Fruit Flavor Concentrates Improve Ice Cream

Results have been obtained from a study of the technology of utilizing concentrated fruit juice and essences in ice cream. The most desirable use levels have been established for peach, blueberry, grape, apple, red raspberry and strawberry flavor concentrates. The supplemental use of 3.5 to 10% fruit equivalent of concentrates improved flavor properties.

The amount of flavoring material, composition of the ice cream mix, and the sugar-acid ratio are factors that have been controlled in obtaining the most desirable flavor. Adjustment of the acidity to pH 5.8, and the sugar content of the mix to not more than 17%, produced desirable effects for the flavors studied, except for apple products, where acidity adjustment did not produce an improvement.

Fruit concentrates and essences have found to be valuable products in improving fruit ice cream flavors, either when used to supplement the use of fruit, or in some cases, when used as the sole source of flavor.

The results indicate that the established flavors of ice cream can be improved by the addition of concentrated fruit juice; i.e., peach or blueberry, and that the use of fruit concentrates or essences offers the possibility of the development of new flavors of ice cream; i.e., grape or Montmorency cherry. *(Project G-42)*

Study Chemistry of Astringent Flavor of Milk Plasmals

Milk heated to temperatures higher than 165°F. has a characteristic tactual flavor often described as rough, chalky, or astringent. This is the most important flavor problem involved in the development of improved concentrated and sterile milks.

The chemistry of this phenomenon has never been understood. Study during the past year has provided a promising lead toward understanding of this problem.

It has been observed that the long chain (C_{16}- C_{18}) aldehydes, resulting from the hydrolysis of milk plasmalogems (a type of phospholipid) impart an astringent flavor when added to fresh unheated milk at levels of 0.1 to 1.0 p.p.m. This flavor is so similar to certain characteristics of heated milk that work is now underway to determine if these aldehydes are liberated in heated milk.

(Projects G-40, G-48)

Find Evidence of New Structure in Oxidized Fats

Evidence obtained during the past year indicates that the B-alkoxyacrolein structure occurs in oxidized lipid material. This structure is hydrolyzed by acids to yield malonaldehyde. This aldehyde is the compound responsible for positive Kreis and Thiobarbituric Acid tests on oxidized fats.

This is the first report to indicate that the unsaturated ether structure occurs in oxidized fats. This structure may have important physiological properties and may constitute a major new pathway of fat oxidation.

(Project G-34)

Colorimetric Milk Fat Test Compared to Official Methods

Further work has been done on the colorimetric hydroxamic acid reaction method of determining fat in milk. The method has also been applied to the determination of fat saponification numbers. The hydroxamate methods were compared to official methods on milk samples from 48 individual cows, 48 samples of mixed herd homogenized, pasteurized milk, and on 32 samples of fat with saponification numbers varying from 192 to 254.

Statistical analysis of the data revealed the following standard errors of estimate: (a) raw milk from individual cows, 0.15; (b) homogenized mixed herd milk, 0.06; (c) saponification numbers, 2.34.

This new approach to fat determination could conceivably lead to the development of automatic electronic equipment for determining fat percentage in milk. *(Project G-35)*

Study Effect of Concentrates on Udder Edema

A mixture of corn and soybean oil meal was compared with a mixture of oats, bran, and linseed oil meal to check their effect on the severity of udder edema. The first ration was fed at a rate of 16-18 pounds per day during the month preceding calving and for the first 2 or 3 weeks following calving. The second ration was fed at the same level and also at a level of 4-6 pounds per day until the edema had disappeared.

No apparent difference in the severity of the edema was found due to the type of ration or due to the level of concentrates fed. This experiment reaffirmed the belief that the level of concentrates and the type of concentrates have little, if any, effect on the severity of udder edema in cows. It was noted that first calf heifers consistently had more severe edema than did older cows. *(Project G-39)*

Compare Feed Value of Corn Silages

Corn silage stored at three stages of maturity was compared with a silage made from a male sterile corn. The three stages of the normal corn were as follows: silks almost dry, kernels in an early dent stage, kernels in a hard dent stage. These silages were fed as the only source of forage to lactating dairy cows along with a protein and mineral supplement.

Four percent fat corrected milk production from the silage made from male sterile corn was about equal to that from normal corn silage at the two later stages. However, the fat test was higher than from the normal corn silages. The early normal corn silage produced the poorest results in terms of milk production and dry matter consumption. These results are preliminary and further tests of the male sterile corn are needed before definite conclusions can be made.

Digestion trials were conducted on a dried corn canning factory waste which was primarily made up of the cobs and husks. The digestible dry matter was 60.2% and the digestible energy content was 1065 Calories per pound of feed. *(Project G-39)*

Cut Alfalfa at Full Bud Stage for Most Milk

The fourth and final year of a study to determine the optimum time to harvest alfalfa to obtain the maximum yield of milk per acre was completed. First cuttings were made at one-tenth bud, full bud, and one-half bloom, and second, third, and fourth cuttings were harvested at the one-half bloom stage. Lactation trials were conducted on the first cuttings and digestion trials were conducted on all cuttings.

The amount of hay consumed decreased 2 or 3 pounds with each succeeding stage of maturity and the digestible energy content decreased 3-4% between stages. The decreases in digestibility and consumption rates were reflected by a reduction in milk production. While the cows produced the most milk per cow on the one-tenth bud stage hay, the greatest yield of milk per acre was obtained with the full bud stage hay. The strength of the stand was not harmed by the early harvesting of the first cutting.

It is now recommended that alfalfa be harvested at about the full bud stage, with the exception that either the second or third cutting be allowed to reach the one-half bloom stage before harvesting. *(Project G-47)*

Study Magnesium Deficiency in Dairy Cows

Studies on hypomagnesemia in cattle fed hay from farms in western Maryland, where "grass tetany" has been a problem, were continued. It was found that the blood concentration of magnesium, calcium, sodium and potassium showed no significant relationship to the onset of tetany. Bone biopsy samples indicated a depletion of bone magnesium in experimental animals. Results indicate that a relative deficiency of magnesium is involved in this disease. *(Project G-37)*

Glycogen Formation and Storage Affected in Ketosis

Information has been obtained concerning the metabolism of radioactive labeled fatty acids by liver tissue from normal cows and from those suffering from ketosis. A high degree of glycogen formation was observed in normal livers. A major defect in ketosis appears to be failure of the liver to produce and store glycogen. Further studies are underway to determine the specific biochemical reactions which are affected in ketosis. *(Projects G-37, G-46)*

Study Rumen Metabolism of Protein

Rumen metabolism of milk protein containing radioactive sulfur has been investigated. Preliminary results indicate that a major portion of the protein is metabolized by the bacteria in the rumen before becoming available to the ruminant. *(Project G-38)*

Liver Metabolism Studies Produce Leads

Studies of liver metabolism of the volatile fatty acids have been continued. They have produced several important leads concerning the mode of glycogenesis from butyrate by the ruminant liver, and suggest that this process is of great importance in milk secretion by ruminants.

Using the *in vitro* technique of tissue slice metabolism, a study of the effect of growth hormone (one of the hormones known to increase milk secretion) on the metabolism of volatile fatty acids by the liver was initiated. Results indicate that the perfusion technique is more useful in studying this problem. Work is now underway utilizing the perfusion method.

(Projects G-38, G-43)

Secretion Rates of Hormones Affect Milk Production

An understanding of the hormones which control milk secretion and the mechanism through which these hormones work is essential to the development of knowledge leading to more efficient milk production.

One of the hormones which has been shown to be detrimental to milk secretion is adrenocorticotropic (ACTH) from the pituitary. The isotope dilution technique for the determination of the rate at which the dairy cow is secreting ACTH into the blood circulation has been refined. Using this technique the secretion rate for a pituitary hormone has been determined for the first time.

These studies have indicated that in animals treated to prevent stress, the pituitary is releasing ACTH into the blood circulation at a rate of 3½ to 5 units per hour. Knowledge of this rate may be of use in certain veterinary treatments.

This technique has proven to be so time-consuming that it is not useful for the measurement of secretion rate in large numbers of animals. Therefore, a different approach to the investigation of adrenal activity has been initiated. In the dairy cow it has been shown that 17-ketosteroids are excreted in the urine and feces as metabolic products of the adrenal steroids and possibly of progesterone.

A technique has been developed for the quantitative assessment of the daily excretion of 17-ketosteroids in the urine and feces. This technique depends upon the use of a radioactive carbon labeled 17-ketosteroid as a tracer for the determination of recovery through the various extraction and chromatographic purification treatments of this quantitative procedure.

In the dairy cow, it appears that the daily urinary and fecal excretion of 17-ketosteroids is of the order of 500 milligrams per day. It is expected that hypofunction and hyperfunction of the adrenal and of the copra lutea in dairy cattle may be assessed, using this measurement. *(Project G-50)*

Study Antibiotics in Control of Bloat

Feeding penicillin to sheep, as sometimes recommended for controlling bloat (25 mg./day), reduced the total bacterial population of the rumen from 10^9/ml. to 10^6/ml. Following continued feeding, numbers of bacteria observed in rumen fluid increased to 10^7/ml. No effect on gas production by the bacteria was noted. Single doses of 20 mg. of procaine penicillin reduced feed consumption by 40% and altered the color and viscosity of rumen contents.

It appears that any action of penicillin in controlling bloat is not a result of decreased gas production in the rumen. It may, however, be associated with reduced feed intake or the viscosity of rumen ingesta. *(Project G-45)*

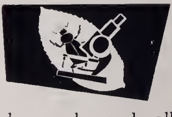
Special Diets Alter Milk Fat Percentage

Feeding diets consisting of heated concentrates and pelleted hay has resulted in a marked reduction in the percentage of fat in milk. The degree of lowering of fat percentages resulting from these diets was as follows: Heated concentrates and normal amounts of long hay, 10-15%; heated concentrates and pelleted forages, 40-50%; heated concentrates and 6 pounds or less of long hay, 5%.

The proportion of acetic acid in the rumen was reduced by approximately 30% when marked changes in fat percentages in milk were noted. Propionic acid content was increased 50 to 100% above normal.

Studies with growing animals indicated that the diets resulting in the altered rumen picture may provide for as much as a 20% increase in the efficiency with which nutrients are used for growth. *(Projects G-38, G-39)*

ENTOMOLOGY



Current agricultural production methods are extremely complex and call for the investment of large sums of money. Producers cannot afford to risk losses caused by insects. Department of Entomology research workers help farmers prevent losses from insect damage, and they are ever mindful of the practical problems involved. At the same time they are seeking the answers to many fundamental questions in the areas of morphology, physiology, toxicology, taxonomy, and ecology.

Insects are studied in the laboratory as well as the field. Here, an entomologist studies the blood cells of insects.

Corn Insects Control Research Progresses

In recent years sap beetle populations have apparently increased, and canners of sweet corn have become more concerned over the injury to sweet corn ears. Sap beetle adults lay eggs under the husks, and the larvae attack the kernels so that extensive culling and trimming of the raw product become imperative. Because of increased cost of labor, canners feel that effective field control measures must be developed so that processing overhead does not reach a point that makes the canning operation unprofitable.

Research has indicated that sap beetle injury can be reduced with the use of organic phosphorous insecticides. Both aerial and ground equipment have been employed in control experiments. Applications of 1 quart of malathion in 2 gallons of white mineral oil by airplane have given highly encouraging results. Initial kills have been very high. Work will be continued on large scale treatments with both ground equipment and airplane, using malathion with mineral oil and with mineral oil and DDT.

Because of the low intrinsic value of canning sweet corn the expenditure for insect control is limited. DDT-oil emulsion sprays have proven effective

Injury caused by wireworm at the base of a young corn seedling. This is one type of damage prevented by pre-planting soil treatments.

Sap beetle larvae on the tip of an ear of corn showing injury caused by these larvae. Organic phosphorous insecticide can reduce or control sap beetle injury.

for earworm control, where several applications can be made, as on market sweet corn. On canning sweet corn, research effort is being directed toward the most effective use of limited applications of DDT-oil emulsion sprays. Ecological studies on time and rate of infestation of the corn ear and seasonal fluctuation in populations are being conducted to provide basic information on timing treatments.

There are several insects that attack corn seed and young plants, the most important of which is the seed corn maggot. In the early spring when the soil is moist and cool, adult flies of the seed corn maggot deposit eggs in the soil. These eggs hatch into larvae that feed on organic material, including the corn seed, in the soil. On large scale commercial plantings, pre-planting applications of heptachlor have reduced seed corn maggot injury and increased stands, especially in early plantings. Soil treatments have also shown effective flea beetle control. Flea beetles are small insects which spread bacterial wilt of corn. The research that has been conducted on pre-planting insecticide soil applications indicates that under certain conditions these treatments are effective and profitable. *(Project H-29-n)*

Develop 3 New Codling Moth Spray Schedules

Experiments on the control of codling moth during 1958 resulted in the development of three schedules that are more effective in the control of this pest than the standard DDT program. Each of the three programs is practical from the standpoint of economy, safety to the operator, and phytotoxicity.

Program No. 1 consists of a combination of lead arsenate, Ryania and parathion instead of DDT. This program gives better control of codling moth than DDT. In addition it is effective against the red-banded leaf roller.

Program No. 2 consists of the use of Guthion as a substitute for DDT and is more effective against codling moth than DDT, and when used in a 12-day program will give satisfactory control of codling moth, leaf roller, leaf miner and orchard mites. Guthion is also partially effective against rosy apple aphids. It is comparatively safe from the standpoint of foliage damage and fruit finish.

Program No. 3 consists of the use of Sevin as a substitute for DDT. It gives excellent control of codling moth. It is partially effective against the red-banded leaf roller and rosy apple aphids.

Codling moth damage to fruit in plots where the different programs were used is as follows: Standard DDT program 26% worms; Sevin 1.5% worms; Guthion .5% worms; lead arsenate, Ryania and parathion 1.0% worms. *(Project H-48)*

Find Substitute for Dormant Spray for Mites

Two major species were involved in these experiments: the European red mite *Metatetranychus ulmi* (Koch), and the two-spotted mites, *Tetranychus talarius* (L.). These experiments consisted of applying miticides in three different seasonal periods, the delayed dormant, pre-blossom and summer applications. The delayed dormant applications had a two-fold purpose, the control of rosy apple aphids and orchard mites.

It was demonstrated that a combination of Superior oil combined with either parathion, ethion or Trithion gave excellent control of rosy apple aphids and suppressed mites until around the first of June.

This development in mite control, combined with the control of rosy aphids, eliminates the necessity of a dormant application and will simplify the growers' problems. The pre-bloom application of miticide is designed for growers omitting the delayed dormant spray.

There are two excellent materials that can be used at this time that will control mites until around the first of June. After the first of June experiments have shown that Aramite or Kelthane will control both species satisfactorily with Kelthane being superior to Aramite in the control of the two-spotted mite. *(Project H-69)*

New Insecticides Give Excellent Protection to Broccoli, Cabbage

Recent tests on broccoli and cabbage have shown that there are several new insecticides which are effective against insect pests of broccoli and cabbage, particularly the cabbage looper. One of the more promising materials is dimethoate; which gave nearly perfect control of all pests. Malathion continued to show effective control, either alone, or in combination with perthane. Other materials which were promising were Thiodan, Kepone and Guthion, although the latter two were somewhat less effective in controlling the cabbage aphid. *(Project H-65)*

Increase Emphasis on Forage Crop Insect Research

Spring of 1959 saw the inaugural of an expanded program on forage crop insect research. Emphasis is currently being placed on the control of alfalfa weevil and other insects injurious to alfalfa. A study of a number of the organic phosphate insecticides has been initiated in an attempt to avoid the difficulty of poisonous residues on alfalfa resulting from the use of chlorinated hydrocarbons.

A joint project with the Agronomy and Plant Pathology Departments is also underway in an attempt to determine the reasons for the decline of Ladino clover. This will be a relatively long term project led by the Agronomy Department. The Entomology Department will be responsible for the entomological phase of the work.

Future work to be undertaken on forage crop insects involves the study of insecticidal residues on forage and the fate of these residues when fed to beef and dairy cattle. Studies on the metabolism of insecticides in insects and in domestic animals will also come under study. The ultimate objectives of this program are to evolve insect control measures for all forage crops, which can be economically sound from the farmer's viewpoint and yet safe from the public health standpoint.

(Project H-71)

HORTICULTURE

The efforts of Horticultural research are aimed at more efficient production of better fruits, vegetables, flowers, and ornamental plants, with the common goal of higher returns for the producer and better products for the consumer. The research program thus involves studies ranging from plant breeding to the canning and freezing of fruits and vegetables, carried on in the laboratories and greenhouses at the University, on the experimental farms, and on the farms and orchards of cooperating growers throughout the state.

Some of the recent results of the research program are briefly presented in the following pages. More detailed information is available in scientific journal papers, station bulletins, and popular articles released by the Experimental Station. The research laboratories, greenhouses and farms of the department are open to those interested in horticultural research, and growers and processors are cordially invited and urged to attend the various programs, field days, and meetings where the most recent research findings are presented directly to the producer.

Study Chilling Injury to Sweet Potatoes During Storage

Sweet potatoes deteriorate when stored at temperatures below about 55° F. This "chilling" injury is apparent as sunken, necrotic areas on the surface, or in severe cases as breakdown of large portions of the root. Secondary rot infections may accompany chilling injury.

In storage tests where a number of varieties were held at 60° F. and at 50° F. differences among varieties were found in susceptibility to chilling injury. The Porto Rico variety showed little or no chilling injury after 5 months exposure to 50°. On the other extreme, Jersey Orange and Nemagold showed slightly injury after 1 month's exposure and almost all of the roots were injured after 5 months. The varieties Goldrush and Carogold showed resistance to chilling injury similar to that of Porto Rico. However, most of the other varieties and the seedling selections under trial showed severe injury after 5 months' storage at 50° F.

The nature of the physiological changes which result in chilling injury is not known. Analyses of roots held at 50 and 60° F. showed little difference in weight loss at the two temperatures. There is a greater accumulation of sugars in roots held at the lower temperature. This accumulation is more pronounced in the Porto Rico variety than in Nemagold or Jersey Orange.

The tests emphasize the importance of proper storage temperatures for sweet potatoes. Continuous exposure to temperature of 50° F. for 1 month will result in chilling injury to susceptible varieties such as Nemagold or Jersey Orange. Additional tests will be made to determine if interrupted periods of low temperature have a similar effect. *(Project Q-79-g)*

Processing Delay Reduces Firmness of Canned Sweet Potatoes

The temperature and duration of the holding period between harvesting and processing has a decided effect on firmness of canned sweet potatoes, as shown by tests with the Jersey Orange and Nemagold varieties. Sweet potatoes were placed in constant temperature storage chambers immediately after harvest and held at 5, 10, 15, and 20° C. Samples were processed after 1, 2, and 6 weeks. An additional lot was subjected to recommended curing temperature (30° C.) for 1 week followed by storage at 15°. Firmness was measured subjectively by panel evaluation and also objectively by use of the recording shear-press.

Storage for 1 week at 5 and 10° did not affect firmness of the canned product. However, longer storage at these temperatures did result in decreased firmness, and storage for 6 weeks at 5° caused a complete loss from chilling injury. The greatest loss in firmness after 1 week occurred when the roots were held at 15°. These samples were significantly softer than those which had been held at the 30° curing temperature. Softening continued at all temperatures during the second week, but there was little change during the next month as shown by analysis of the samples processed after 6 week's storage.

Although analyses of the roots showed changes occurring in percentage dry matter, starch, and sugars during the storage period; these were not found to be closely associated with the decrease in firmness of the processed product. Preliminary work has suggested that changes in the amount and nature of the pectic constituents of the roots may be the principal factor affecting firmness. These studies are being continued. *(Project Q-79-G)*

Check Adaptability of Snap Beans for Mechanical Harvesting

With the use of machine harvesting, which permits only one picking, it is essential to find the most appropriate time to harvest each variety. It is necessary to obtain both profitable yield as well as the greatest degree of utilization of the total yield by the processor.

The varieties White Seeded Tendergreen, Tenderwhite, Corneli 14, Harvester, Pearlgreen, and Tendercrop were tested. The 1958 main season crop received ample rainfall and temperatures were moderate. The yields obtained at a time when the entire lot of beans were in the lower range of acceptability with respect to the processed grade, ranged from 2700 to 4400 pounds depending on the variety. Only White Seeded Tendergreen was found to be unacceptable at an early stage because of rapid fiber development. The yield and processing attributes of each variety are described in detail in Horticulture Mimeo 17.

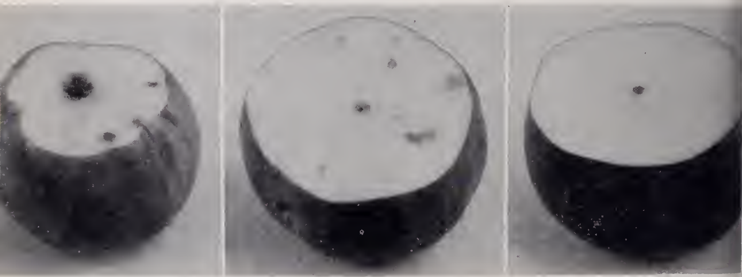
New Compounds Tested for Spray Thinning of Peaches

Annual thinning is required to produce adequate fruit size at harvest in Maryland peach orchards. While hand thinning is costly, Maryland growers continue to do this job by hand because, up to the present time, chemicals developed for spray thinning had to be applied during the blossoming period or very shortly thereafter. The frequence of frosts after bloom in Maryland makes such spraying hazardous. Considerable attention has been given to testing new materials which could be applied well after bloom, or after the frost period is over.

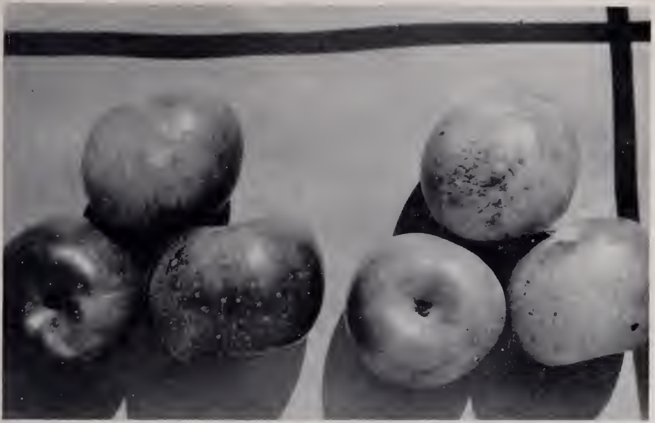
In 1956, 25 new chemicals were screened on Halehaven peach trees for thinning activity. Out of this group, two have been found to be promising for the purpose. These two, 2 chlorophenoxy alpha propionic acid (2CP) and 3 chlorophenoxy alpha propionic acid (3CP), were tested extensively in 1957 and 1958. Both chemicals produced excellent thinning when sprayed from 10 to 30 days after full bloom. Both were found to have no adverse formative effects on fruit shape, and neither produced premature or uneven ripening. At higher concentrations both compounds will produce moderate wilting of leaves on the trees for a short period, but experimental sprays at concentrations high enough to defruit the trees indicated that both 2 CP and 3 CP have wide margins of safety. At the present time, 2 CP and 3 CP are the only promising chemicals available for delayed spray thinning of peaches. *(Project L-74-b)*

Control Found for Bitter Pit in Apples

Bitter pit of apples has been studied throughout the world since it was first reported in Germany 90 years ago. This disorder is characterized by corky areas of flesh tissue which are situated either immediately subtending a surface depression in the skin of the fruit, or are deeply embedded in the flesh



Bitter pit of the York Imperial apple. Left: cross section of a typically affected fruit showing surface depressions subtended by localized regions of corky tissue in the flesh. Middle: Deeply embedded corky tissue with no surface depressions. Right: Normal fruit.



Good fruit color and finish produced by boron sprays. Left: Sprayed with boron during the blossoming period. Right: unsprayed fruits.

without any surface indication that they are present. The cause of bitter pit has never been discovered, and no control was known. The disorder has plagued Maryland apple growers for years, particularly those producing the York Imperial variety. The No. 1 apple variety in the state.

Work was initiated on this problem in 1957 with the thesis that bitter pit was related to boron metabolism, even though the disorder has never been corrected in experiments elsewhere with soil applications of boron. For the last two seasons, boron sprays have been applied to different sets of York Imperial trees at various times during the season from the late dormant period to harvest.

It was found that bitter pit in the York is related to boron metabolism, and that the disorder can be corrected with boron sprays, but only if the sprays are applied during the blossoming period. Spraying either before bloom or any time afterwards failed to influence the incidence of bitter pit on mature fruit.

Deeply embedded corky areas had been found to increase in the storage period, but this phenonema too was controlled by boron sprays applied in bloom.

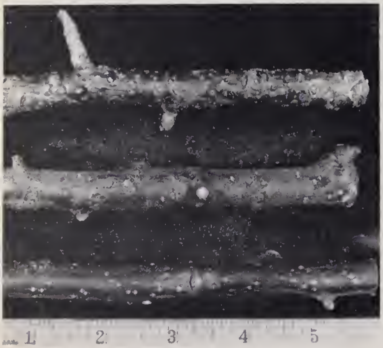
In the very dry season of 1957, dramatic effects on color and finish of the fruit were produced by boron sprays applied in bloom. Fruits so treated developed abundant good red color and a smooth finish, compared to virtually no color and rough finish on unsprayed fruits and those sprayed with boron at all times other than the blossoming period.

Skin cracking, long a problem with the York variety, was virtually eliminated by the boron sprays applied in bloom.

In 1958, good color and finish developed on all fruits, but differences were still evident in favor of fruits sprayed with boron during the blossoming period. *(Project Q-79-b)*

Apple "Measles" Not a Manganese Toxicity

Internal bark necrosis of the apple, commonly called "measles", has been studied in the United States and the United Kingdom for many years. Most severe on the Red Delicious variety, the disorder causes progressive loss of productivity of the tree and, in severe cases, ultimate death of the plant. After pathologists established that no disease organism was involved, physiologists explored the mineral nutrition of the tree to determine the possible cause of this widespread disorder. Work in recent years has indicated that toxic levels of manganese were responsible for the development of necrosis, and the most common recommendation to fruit growers has involved heavy applications of lime in the orchard to "tie up" mangane in the soil and thereby inhibit absorption of this element by the trees.



Top: severely necrotic bark from a Delicious apple shoot infected with internal bark necrosis, or "measles"; middle: mildly necrotic bark; bottom: normal bark.

Preliminary work on necrotic Delicious trees in Western Maryland indicates that the disorder in this state is not due to toxic levels of manganese in the trees.

Complete chemical analysis of leaves and bark tissue during the growing season from June to November indicates that calcium metabolism of the tree is in some way involved in the disorder. Calcium was found to accumulate in the leaves of nectrotic trees as well as "normal" trees in the affected orchard thru the latter part of the season. and rather high calcium levels were found in 1- to 4-year-old bark at leaf fall in November. At no time during the season was manganese found to be above normal levels in the trees under study.

Work is being continued to determine the role of calcium metabolism in the development of internal bark necrosis. *(Project Q-79-b)*

Pot-Plant Fertilization is Changing

Pot-plant fertilization is changing rapidly under greenhouse conditions. The advent of completely soluble types of fertilizers this makes it possible for them to be applied in a dilute solution through the water system or by special watering devises. This provides a method of controlling plant growth more easily and without additional labor costs.

Previous studies have shown the value of using a fertilizer mixture high in nitrogen, a 2½-1-1 ratio or as a 25-10-10 material. Favorable response to this type of fertilization has been obtained on many pot-plants.

Several examples are mentioned:

With gardenias as pot-plants, an increase in the number of flowers and size of flowers was obtained with using a 25-10-10 fertilizer solution at the rate of 2 oz. to 100 gallons of water every time the plants needed watering.

Poinsettia stock plants supplied regularly with similar fertilizer at 2 or 4 oz. to 100 gallons of water produced larger plants with consequently more cuttings per plant and a heavier root system on the cuttings. This is compared to the less frequent application of a dry fertilizer or more dilute applications of the liquid types.

Pot-grown chrysanthemums produced larger plants both in height and total weight when receiving 6 oz. to 100 gallons than lower amounts.

Other flowering plants responding to this method of fertilization included cyclamen, begonias, hydrangeas, and geranium. *(Project I-74-a)*

Phosphorus and Calcium Increase Flowering of Geraniums

Well-fertilized geraniums produce more flowers and become larger plants than less well-fertilized plants. Many growers fail to fertilize geraniums since they have found that with improper fertilization it is easy to stimulate growth at the expense of flowering. This is not desirable either commercially or in a garden planting.

In a study recently completed, it has been found that the greatest growth and flowering was produced by additions of both phosphorus and calcium. When either material was in low availability or not applied, that there was less response. Applications of potassium did not produce a significant response of the plant either in growth or flowering. Nitrogen was applied to all of the treatments uniformly so that it was not a varying factor in these studies.

For these studies, a well-drained soil mix was used, composed of equal parts of loam and peat.

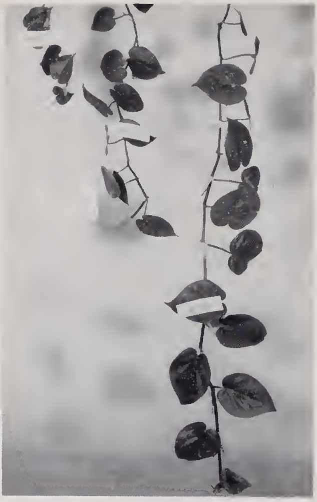
The results of this study confirm studies on other floral crops that growth and flowering are promoted best with high levels of nitrogen and phosphorus and with this plant, calcium as well. *(Project I-74-a)*

Schedule Determined for Production of Poinsettias

The increasing importance of pot-plant production in Maryland greenhouses has made desirable the formulation of precise production schedules for various crops. This information has not been available for poinsettias, the most important Christmas crop.

Based upon 10 years' work with this crop, schedules have now been prepared for use under Maryland conditions whereby greenhouse operators can plan in advance each detail of growing this crop, from the production of cuttings to the finishing of the crop for Christmas sales. The program includes methods for efficient production of cuttings, starting the young plants, and timing the flowering of the crop.

The newly developed timetable for production of poinsettias will help growers turn out plants like this one, produced from cuttings taken on Aug. 25 and pinched (topped) on Sept. 25.



Philodendron respond to phosphorous fertilization. These stems are from plants receiving similar amounts of nitrogen and potassium but varying amounts of phosphorous. Left: none; middle: low amount; right: high amount.

Particular attention is given to the control of the quality of the plants so that plants with a maximum usefulness to the consumer can be produced.

One of the most popular and profitable sizes is grown in a 6-inch flower pan using 4 or 5 cuttings to produce as many flowers. As an example of the production schedule the following procedure has been recommended to the growers: Stock plants from which cuttings are to be taken are pinched on June 1, July 10, and August 15. Cuttings are taken on September 20. They should be inserted in a 6-inch pan filled loosely with a mixture of soil and peat moss. The cuttings are then placed under intermittent mist for a period of 20-24 days to form roots. The plants are then removed from the mist and grown at a minimum night temperature of 60° F. A similar plant can be grown from 3 cuttings if they are taken August 25 and the young plants pinched on September 25.

Other sizes of plants must be propagated at different times. Temperature control is important in timing the flowering of the crop and in controlling the plant height and other quality factors. *(Project I-74-a)*

Complete Study of Quality Factors for Canned Apples

A 3-year study, just completed on apple products, has shown apple varieties vary in their suitability for slices and sauce. In general, the same varieties which make a good slice pack will also make good apple sauce. Soft apples used in making sauce, however, are not suitable for slices.

Varieties are ranked in the following manner for slices and sauce. 1. York Imperial. 2. Golden Delicious. 3. Jonathan. 4. Stayman. 5. Rome Beauty. 6. Northwest Greening.

Many experts had a difficult time deciding whether York or Golden Delicious was best for a single variety sauce. In sauce blends, 50-50 mixture of York and Jonathan and equal mixtures of York, Golden Delicious, and Stayman gave the best results.

In considering the attributes for slices, York gave a firm, whole product; Golden Delicious a bright, whole slice; Jonathan a tart, firm slice; Stayman a flabby, soft slice; Rome Beauty a soft, tasteless slice, and Northwest Greening generally a low quality product for all factors.

In sauce, York gave grainey texture and good color; Golden Delicious a bright golden color and high solids; Jonathan very high tartness and bright color; Stayman high acidity and high pectic constituents; Rome and Northwest Greening showed no particularly outstanding quality features.

It was concluded that apples harvested in a very immature condition should be allowed to ripen slightly before making them into slices or sauce. Much of the starch will be converted into sugar during this short ripening period. *(Q-58-p)*

Procedure to Minimize Separation in Canned Apple Sauce Developed

Results of a 3-year study of liquid-solids separation (lyophoresis) in canned apple sauce show it is especially severe in sauce made from apples of late harvests and long storages. Many sauces from these harvests and storages will exhibit liquid separating from the pulp when placed on a flat plate. This separation is highly undesirable and the consumer will discriminate against sauces showing this phenomena.

Research results show that pectin content (high and low methoxyl pectins), starch content, pH level and particle size of the sauce account for a large part of the variation in liquid-solids separation. Viscosity of the separating liquid is also found to be closely associated with the amount of separation ($r=0.90$). The higher the viscosity of the liquid portion, the lower the amount of liquid separation.

Increasing the viscosity of the liquid phase by additions of a 50-50 mixture of . 25 - .50 high and low methoxyl pectin and a reduction of sauce pH to 3.3 - 3.4 has substantially reduced liquid-solids separation.

(Project Q-58-p)

Objective Method for Evaluating Quality of Lima Beans and Peas Studied

Maturity of lima beans and peas has been determined by instruments which measure the resistance to shear and compression or to the puncture characteristics. A new technique has been developed which is low cost, precise, multi-product, and relatively fast.

The proposed procedure measures the rheological properties of slurries of blended vegetable tissues and water. Raw, blanched, canned beans, and peas may be tested in this manner. The flow of these slurries on a flat surface is directly related to the amount of alcohol insoluble solids in the mixture. Flow is greatly limited in samples containing a high percentage of AIS.

Correlation coefficients between slurry flow readings on an Adams Consistometer and other objective measurements of quality such as the tenderometer, shear-press and % AIS of the canned product are 0.90 or higher. Indications are this procedure may be quite useful in supplementing existing test equipment. *(Project Q-58-f)*

POULTRY

The United States is one of the few countries of the world that can afford as extensive an animal agriculture as is maintained here. Many of the less fortunate countries find it necessary to eat cereal grains rather than eating animals that have in turn consumed the cereals. In spite of our abundance of livestock

One of the experimental pens in the newly completed broiler experimental house at Salisbury, Md. The heating system consists of finned tubing covered with a beaverboard shield.

feeds, it behooves American agriculture to make the most efficient use of the feedstuffs in the production of animals for consumption.

The chicken is probably the most efficient animal in turning feedstuffs into human food. This is party so because of the extensive research program which has led to the production of better bred animals, disease prevention, and more efficient rations. Research in poultry is directed toward the improvement of the broad field of poultry husbandry, seeking always to make the bird an even more efficient converter of feed into human food.

Heated Full-fat Soybeans Replace Soybean Meal, Fat for Broilers

Both battery and floor pen broiler trials have been conducted in studying the temperature and moisture conditions necessary for treatment of unextracted full-fat soybeans as the replacement for all of the soybean oil meal and all or part of the added fat in broiler feeds.

Steam heat applied at atmospheric pressure for 30 minutes produced satisfactory results when 5% water was added to the ground beans prior to treatment. Heating at 15 lbs. pressure for 5 to 10 minutes also gave similar results.

More recent work indicates that "flaking" of the soybean rather than grinding gives slightly better results, being equally as good as those obtained with soybean meal and soybean oil.

These findings may be quite important for the broiler industry of Maryland should the price of soybean oil continue to drop. *(Project M-200)*

Efficient, Simplified Broiler Feeds Developed

Improved, simplified, efficient corn-soybean oil meal type rations for broilers have been developed. These rations are based on recent Maryland work involving improvement in protein quality, higher choline levels, zinc supplementation, unidentified factors, and the consideration of amino acid requirements primarily as a function of energy content of the feed.

Since methionine is the first limiting amino acid in broiler feeds, the addition of this amino acid can extend the protein by approximately 10% before other amino acids become critical. Ample choline further spares the need for methionine supplementation. Glycine supplementation was of no value.

Such feeds perform well even though the actual protein level is lower. This is accompanied by an improvement in potency and feed conversion with a slight reduction in total cost.

(Project M-202)

Temperature Affects Nutritional Requirements

Studies have been initiated in batteries at controlled constant temperatures betwen 50° and 90° F. in order to study the effect of temperature on nutritional requirements of broilers.

Feed efficiency and gain in weight from 5 to 8 weeks was reduced at temperatures of 50° F. as compared with that of controls held at 75° F. Growth was also reduced at 90° F., but feed conversion was affected little. Higher levels of protein did not prove effective in overcoming the growth depression at these temperatures. *(Project M-200)*

Protein Requirements of Hens Studied

Rations containing 11, 13 and 15.3% protein were fed to SCWL pullets with improvements in egg production as the protein level was increased. These results do not agree with recent data obtained at certain other universities where 13% protein in the ration proved adequate. The explanation appears to be due largely to differences in feed consumption per pound of eggs.

(Project M-35-m)

Recently completed broiler experimental house at Salisbury, Md. This house is 25 feet wide and 340 feet long, and contains 32 separate pens.

Zinc Required for Growth, Bone Formation and Hatchability

Studies have been continued on the role of zinc in bone formation and growth in turkeys with consistent responses obtained from the addition of zinc to feeds already containing 40 parts per million of zinc. These findings demonstrate clearly the need for zinc supplementation of practical feeds for turkeys.

Other studies with laying hens fed highly purified diets have confirmed previous Maryland findings that zinc is necessary for eggshell formation and hatchability. *(Project M-203)*

Five Weeks Best Time to Switch Broilers to Finishing Ration

Feeding trials have shown that female broilers may be changed to finishing rations as early as 4 weeks with no adverse effects. However, the growth rate of males was slightly reduced when the finisher ration was begun at 4 weeks.

It appears that 5 weeks is about the time to change from the starter to finisher feed, where a two-feed program is used. *(Project M-200)*

Study Unidentified Factor Sources

Both dried whey products and corn fermentation solubles were fed to broilers without any improvement in results. This is consistent with other recent studies at the University of Maryland and elsewhere, suggesting that these materials are not critical to the adequacy of practical rations.

The need for animal protein supplements also has been studied with 2.5% condensed fish solubles, giving no response when supplied as the only source of animal protein. But with 2.5% menhaden fish meal plus 3.75% poultry by-products meal, slight but consistent growth responses were obtained. The average increase in body weight of broilers at eight weeks is 0.06 lbs. with no change in feed conversion. *(Project M-201)*

Test Vitamin Supplementation for Broiler Feeds

In two trials, vitamin B_6 (pyridoxine) has been added to practical broiler feeds as a result of work at the University of Georgia which suggested that this vitamin might be marginal in certain practical rations. In one of these trials, biotin, folacin, ascorbic acid, and additional menadione sodium bisulfite also were included.

In one test a questionable response was observed when pyridoxine was added, while no response was obtained from any of these vitamins in the other.

Additional work is under way to evaluate further the critical role of these nutrients in practical feeds.

(Project M-201)

Compare Fat Level in Mash and Pelleted Rations

In two trials, pelleted feeds containing 2% added fat were compared with mash feeds containing 7% added fat. Using "stretched protein" rations, the 2% added fat pelleted feeds gave results comparable with those obtained with 7% added fat rations fed in mash form. Since previous work had shown that these higher fat mash rations were comparable with other feeds containing more protein, it appears that 2% added fat pelleted "stretched protein" rations also may be used satisfactorily.

In this connection, too, broilers have been raised on pelleted rations containing 2% added fat to 5- or 6-weeks of age, then changed to mash rations containing 7% added fat. Similarly, broilers have been maintained on mash starting rations containing 7% added fat to 5- or 6-weeks, and then changed to pelleted feeds containing only 2% added fat. No differences in performance were noted when differences in nutrient potency are considered.

(Project M-54)

Dressing Percentages Vary by Sex and Size

Results obtained from broilers at 8, 10 and 12 weeks of age have revealed that the dressing percentage is greater in female than in male broilers and increases with size. *(Project M-200)*

Evaluate Broiler Production Costs, Best Age to Market

In order to properly determine the way to produce the lowest cost broiler meat, it is necessary to calculate this in terms of per pound of eviscerated product rather than per pound of live bird, since dressing percentage and cost of processing can materially affect the cost of production.

Accordingly, results obtained during the past several trials were combined and the estimated cost of production and processing appeared to be lowest for females at 9 weeks, and for males at 10 weeks. The lowest cost for mixed sexes was at 10 weeks.

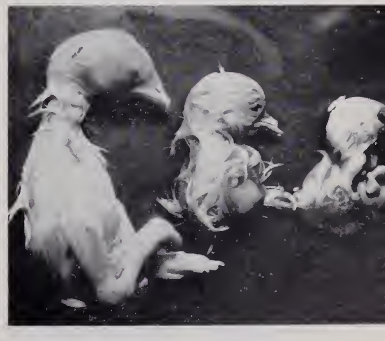
The advisability of rearing broilers separately at this time does not appear economically favorable without special market outlets, until autosexed broilers become available to the industry.

(Project M-200)

Study Metabolic Inhibitors in Chick Nutrition

Work has continued on the trunkless malformation produced in chick embryos by the injection of 1,2 dichlor-4,5-diaminobenzene, an inhibitor of vitamin B_{12} and riboflavin synthesis in microorganisms. This inhibitor is most effective in producing this condition if it is injected when the embryos are 1½ to 3 days old and in doses of 300 or 500 micrograms per embryo. The mechanism of this inhibition has not been determined.

Heme is found as the iron porphyrin portion of hemoglobin, and in some very important enzymes such as catalases, peroxidases and cytochromes. Hemin (heme chloride) and some non-metalloporphyrins have been found to inhibit growth markedly when injected into young chicks, and produced out-



Abnormal embryo development resulting from the injection of B_{12} inhibitors into the egg. The inhibitors allow normal head development but inhibit trunk development.

wardly bowed legs in a large number of survivors. These symptoms are similar to certain nutritional deficiencies.

A study is being made of how the chick handles an excess of these normal body components. *(Project M-49)*

Find Magnesium Levels for Chicks and Poult Diets

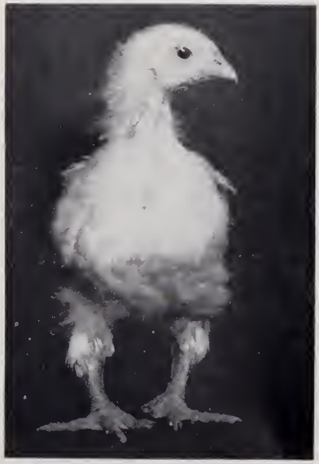
Acute magnesium deficiency in the chicken and poult is characterized by convulsions, tetany, and high mortality. Borderline magnesium levels reduce growth. For optimum growth, the chick requires 200 p.p.m. Mg., the poult about 300. The omission of an antibiotic from the diet appears to increase the need for maganesium. In the turkey poult, deficiency of the element leads to abnormal feathering similar to that found in zinc deficiency.
(Project M-203)

Work to Find Biochemical Mechanisms of Perosis

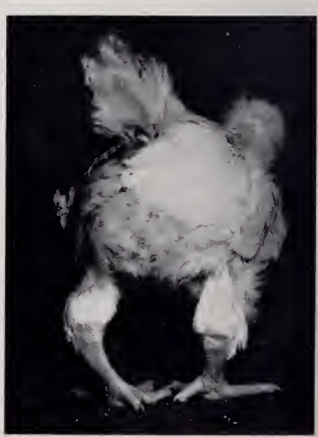
Perosis is a bone abnormality found in chickens and turkeys. Its common characteristics are bowed legs, enlarged hocks, and displacement of the tendons from the grooves in which they manipulate.

Although perosis has been identified for at least 30 years, and is known to be caused by deficiencies of several nutritional factors, the biochemical mechanisms involved are unknown. Work has been directed toward determining this mechanism in hope that the results may have practical benefits in animal and human nutrition and medicine.

Most of the factors involved in perosis deal in some manner with purine, pyrimidine, and nucleic acid metabolism. Results thus far indicate



Bowing and twisting of chick legs as the result of nutritional (biotin) deficiency.



Experimentally induced hock disorder resulting from hemin injection. Hemin is the part of the blood compound responsible for oxygen transport.

that the addition of nucleic acids to purified diets deficient in the perosis-producing entities may markedly increase growth, but do not specifically cure perosis. *(Project M-204)*

Study Protozoa and Viruses in Basic Nutritional Research

The protozoan *Trichomonas gallinae* continues to furnish information which will be useful in the study of fat and steroid metabolism. This cholesterol-requiring single cell animal can only use steroids closely related chemically to cholesterol. It is not able to use steroid sex hormones, or steroids similar to cortisone and bile acids. Nor can it use chemicals which are used by other animals in the synthesis of cholesterol and other steroids. These observations help to explain why these organisms are pathogenic parasites. They must get their nourishment from the host animal which has an ample supply of cholesterol and fatty acids.

The relationship of the nutritional status of the host to the course of virus infection has been studied in chicks. Several diets rich in egg yolk and whole egg were studied for their effect on the course of Rous sarcoma, a virus-produced tumor. No effect was found, thus refuting, for this disease at least, the report that eggs contain a carcinogen. *(Project M-48)*

Study Effect of High Ambient Temperature on Egg Shell Thickness

Further studies have been conducted on the feeding of NH_4C1 at normal temperatures. Albumen quality was improved at normal temperatures as it was at high ambient temperatures but there seems to be an additive effect of NH_4C1 with temperature.

Various salts have been added to the diet at high and normal temperatures with some beneficial results on shell thickness. However, in nearly all cases, when shell thickness was improved, production dropped.

Preliminary work has been initiated to study the alkali reserve to determine if there is any correlation with blood alkalinity and shell thickness.

(Project M-53)

Measuring the thickness of egg shell to determine the influence of different feeds on shell quality.

Measuring the shell strength of eggs by recording their specific gravity.

Gas Anesthesia Helps Produce Good Carcass Color

Studies indicate that the faster the birds get into the scald water after bleeding, the easier the feather removal; however, the carcass has more redness. When the birds were bled a longer time, the carcasses had good color but feather removal became more difficult. When broilers were bled for 60 seconds, the carcass had very little redness and feather removal was not too difficult.

Work with gas anesthesia indicates that its value lies in killing the bird before it enters the scald tank. It appeared that if the bird was unconscious and not struggling when it entered the scald tank, the best carcass color resulted. *(Project M-100)*

Study Composition Detection of Meat Spots in Eggs

Work was continued on determining the incidence of meat spots in eggs. All eggs from hens on experimental diets have been checked, including kelp ash, corn oil, various protein levels and several lighting methods with no difference in the incidence of spots. The chromatographic pattern of the protein in meat spots and blood was found to be different. *(Project M-51)*

Check Serum Cholesterol and the Performance of Chickens

Cholesterol is a compound found in the body and blood stream that is of considerable importance. Besides its suggested relationship to circulatory diseases, it is also known to be involved in the synthesis of sex hormones. Since these hormones are involved in the production of eggs, a study of the relationship of cholesterol to reproductive traits such as egg quality, egg production, and sexual maturity has been undertaken.

Very little evidence has so far been obtained of any relationship between cholesterol level in blood serum and reproductive traits. However, it has been possible to breed a line of White Leghorns which differ markedly in the cholesterol of their blood serum. It is hoped that by following the performance of these lines for the first 2 to 3 years of the bird's life any relationship between cholesterol and reproduction or aging of the bird will be detected. The only consistent difference in these lines noticed to date has been that the high line starts laying at a later age than does the low line with the control line approximately intermediate to the high and low lines.

(Project M-33-e)

Study Effect of Alkaline Phosphatase Concentration

Experiments are under way to determine the relationship between the alkaline phosphatase level of blood serum at 6 weeks of age and subsequent egg production.

Two approaches are being used to study this: One is a statistical evaluation of the relationship between egg production and alkaline phosphatase (results to date indicate a significant and positive correlation between these two). The second approach involved producing a strain which has a high level of alkaline phosphatase in its blood to see if egg production is increased in such a strain.

After two generations, a high line has been obtained and the figures from 1 laying year indicate that the egg production in the high alkaline phosphatase line is roughly 5 to 10% higher than that of the control line; however, it will take several years before any definite conclusions can be drawn.

(Project M-32-m)

Seek Ways to Store Chicken and Turkey Semen

Research with chicken semen lags greatly behind the research done with the larger mammals, such as cattle. And although it is now routinely possible to freeze bull semen for several months, if not years, with very little reduction in the fertilizing ability of the semen, very little success in this respect has been obtained with chicken semen.

The difficulty apparently lies in the harmful effect of glycerol on the chicken semen. Even when the chicken semen is not frozen, the presence of glycerol will reduce the fertility from such semen to zero.

Our research has involved tests of different ways of removing the glycerol after freezing. Results have been very promising and a substantial number of fertile eggs have been obtained from semen that was frozen and the glycerol removed by a process of further dilution of the semen and washing out the glycerol, using a centrifuge.

Other studies have also been conducted in an attempt to extend the time which chicken semen can be stored without freezing. These investigations have shown that fertility is improved if egg white and fructose are added to the diluent.

It is now possible to obtain some fertile eggs from semen stored for 2 days and also to store semen up to 8 hours without any loss in fertilizing capacity. Preliminary work with turkey semen has resulted in very low fertility when it was stored.

A third aspect of this project has involved studying the carbohydrate metabolism and breakdown by chicken sperm.

Results of these studies should eventually enable us to formulate better methods of semen handling.

(Project M-300)

Continue Development of Productive Strain of Turkeys

A selection regime has been continued for the production of a medium-sized strain of turkeys with superior reproductive capacity and rapid rate of growth. This strain of birds is somewhat smaller than the conventional Broad-Breasted Bronze or large white strains on the market today, but considerably larger than the Beltsville White birds, and is a size very desirable from a merchandising point of view.

A continued program of selection has markedly increased the reproductive performance of the birds as measured both by number of eggs produced and hatchability of all eggs set. The birds have been made available to commercial producers, and are being incorporated into the strains of commercially available turkeys.

(Project M-34-e)

Test Perception and Preference of Hens for Different Color Nests

In a previous report, we related the over-all preferences of chickens for colors, using the nest as a medium of choice. It was apparent, however, that there was much variability in response, suggesting that other factors might be involved, such as bossism (peck order), crowding (nest occupied), and location preference.

This year we endeavored to study individual response in a trapnested pen of 50 birds, and tried to eliminate the mentioned social factors by very frequent trapnesting. This was not successful.

The technique finally used was to study a single bird in a small pen, with all nests open, and give her a choice of two colors only. If she showed a continued preference for one color, that nest was immediately closed to distinguish if we are dealing with a color or a positional preference among nests.

We are finding that the chicken is a creature of habit as far as nest positional preference is concerned. Some layers have a definite preference for a single color, and will lay anywhere if that color is available. Others are not so particular, and color preference is secondary to nest position.

(Project M-55)

Investigate the Causes of Molt

The physiological stimuli which result in feather regeneration are very poorly understood. This project involved a fundamental approach to this problem.

Capons were used as the experimental animal to test the effects of androgen, estrogen, luteinizing hormone and follicle-stimulating hormone in causing feather regeneration. Local deplumage was performed at weekly intervals and subsequent to the administration of the relevant compounds.

Androgen response was checked in growth changes of the head-furnishings; estrogen response was checked in the feminization of the plumage. Where there was evidence at toxic levels, both androgen and estrogen inhibited regeneration. However, when the dosages used produced "physiologically normal" responses in comb and feather, regeneration proceeded normally.

The luteinizing hormone and follicle-stimulating hormone were equally negative, although there was a slight indication that the follicle-stimulating hormone exerted some inhibition. The problem of seasonal inertia in the plumage of the cock and hen, therefore, has not been clarified from this approach. *(Project M-32-L)*

RURAL SOCIOLOGY

During this fiscal year two reports, under NE-31, The Effects of Urban-Industrial Expansion on Northeastern Agriculture, have been published. The first, a Maryland publication, deals with population change and urbanization in the Northeast and the second is a bulletin published by the Delaware station. A third publication describes social and economical trends in Calvert County, Maryland.

N. E. Population Shows Urbanization Trend

The Northeast's population shows a pronounced tendency toward urbanization. This tendency has affected intra-regional population mobility and has attracted many residents to the region's industrial centers. Data analyzed in this report also indicate the need for community development efforts in communities of differing mobility characteristics. For example, communities that are losing population, suburban areas that are receiving heavy inmigration and central cities that have transient populations are all undergoing social and economic changes. Some of this may be attributed to population change. In these areas community development may be a common need, but the direction and focus of these efforts will vary with the quality of mobility.

The Delaware bulletin depicts the state's population composition and change. This publication provides basic demographic data on which researchers may fruitfully build future research efforts and, in addition, provides information that may be applied by community organizations in meeting local problems born of population change.

A third manuscript has been prepared for final review during this fiscal year. This document will provide demographic data of a historical nature for the Northeast and its Divisions which may be used as bench mark data by demographers in the Northeast as they publish analyses based on the 1960 Census. This manuscript has been executed by demographers in the Branch of Farm Population and Rural Life, AMS, USDA, and Maryland workers.
(Project S-3-2)

Urban expansion into rural areas is shown by this row of mail boxes and newspaper receptacles. A majority of the families receiving rural delivery mail also receive a metropolitan newspaper.

Calvert County Farmers Shift to Off-Farm Work

Calvert County farmers rely on nonfarm work as an income source for their household. Government is a large employer of local residents. There are other dramatic scales of change in income, educational level, and population mobility of residents of this county shown in the recently concluded study of Calvert County.

An additional publication is under preparation that will provide a detailed description of the Negro labor force in this county. According to labor force researchers, the Negro labor force in rural farm areas constitutes a population segment whose development potential promises great yields to the economy and society. Specific analyses of this segment have been lacking and the publication has been conceived as filling a gap in labor force literature. This project has been executed by the Farming Efficiency Section, ARS, USDA, and Maryland personnel.

In addition to these publications, plans are under way for two journal articles. One deals with communication among residents in this county and the second with urbanization's influence on rural areas. *(Project S-5)*

VETERINARY SCIENCE

The economic and public health significance of diseases of animals and poultry influence the choice of research projects. Some diseases are important as they affect only one of these considerations, whereas some others have importance in financial returns and human health.

In addition to the regular projects, some pilot studies are conducted in conditions which arise, but which do not immediately seem to justify a full place in the research program.

Investigate "Air-Sac" Infection in Domestic Poultry

"Air-Sac" infection continues to be one of the major disease problems confronting the poultry industry. This condition technically is called aerosaccitis. Several organisms including viruses, bacteria and fungi are known to cause or be associated with this ailment of the fowl. One of the organisms most commonly found to cause aerosaccitis is commonly referred to as the avian pleuropneumonia - like - organism (PPLO). This organism scientifically is designated *Mycoplasma gallinarum*. While formerly it was thought of as a virus by some, it is now considered to be a bacterium in view of its ability to multiply in laboratory media outside the body of an animal.

It was early recognized, however, that the avian pleuropneumonia-like-organism often was found to be associated with other bacteria in diseased air-sac tissues. The identity of such associated bacteria naturally has a vital bearing on the kind of drugs most effective in combating the disease. A study, therefore, was undertaken to determine the nature and relative numbers of such associated organisms.

Groups of experimental young turkeys were accordingly inoculated with PPLO and killed at various intervals of time afterward to find out what kind of germs were present with PPLO. In experimental birds, killed 2 and 4 days after inoculation, PPLO were found to be associated with the bacterial organisms (Grampositive) that inhabit the respiratory tract of normal turkeys. By the 7th day after injection, however, it was learned that the bacteria formerly present in the windpipe with PPLO had been predominately replaced by other species (coliforms) and that all bacteria were increasing in numbers. A study of birds 10 days after inoculation showed that this condition was striking deeper in the body and invading the lungs and air sacs. This period coincided with the period during which symptoms were noted.

In addition to studies of birds artificially infected with the disease, several naturally infected cases of air sac disease were studied. PPLO were found in all instances and the type of other bacteria present was in general agreement with results obtained from artificially infected cases. *(Project D-59)*

Test Protective Value of Newcastle-Immune Serum

For more than a decade Newcastle disease has constituted a serious problem confronting the poultry industry. During this period flock vaccination with live-virus vaccine has been widely practiced. While vaccination has proved beneficial on the whole, results obtained with the best vaccines developed to date fall short of ideal protection against the disease. On the one hand, the incidence of Newcastle in many sections of the country has not decreased during the period when live-virus vaccination has been practiced. On the other hand, the so-called virus-breaks occur too frequently particularly in congested poultry areas. For these reasons the development of innocuous immunizing agents has been attempted. In foreign lands, some attention has been given during recent years to studying the protective value of Newcastle-immune serum. Little attention has been devoted to this subject in the United States.

In current experimental work, Newcastle-immune serum has been collected from broilers that had been vaccinated with live-virus vaccine. Blood serum possessing strong protective value when tested against embryonating chicken eggs was fractionated by the methanol method of Dubert to obtain the gamma globulin portion known to contain immune bodies against disease. This fraction represented about 27% of the whole-blood volume.

In hemagglutination-inhibition tests, immune globulin had a reaction value 2½ times greater than whole immune serum. In experimental groups of birds, 2 mls of immune globulin protected 95% of the birds artificially exposed to Newcastle disease at the same time. When artificial exposure to disease was delayed from 1 to 3 weeks, immune globulin was less effective. Immune globulin was less effective against large doses (10^6 ELD_{50} units) than against moderate doses of virus (10^3 ELD_{50} units). *(Project D-52)*

Find Only Eastern Type Encephalomyelitis Virus in Md.

Studies of equine encephalomyelitis in Maryland have shown that the infection is limited to tidewater areas and that the majority of animals exposed to the virus in nature as well as in the laboratory develop only subclinical illness rather than obvious disease.

It has also been found that only the eastern type of equine encephalomyelitis virus is active in Maryland at present. The western type has, however, been isolated in New Jersey.

To date, all attempts to isolate encephalomyelitis virus from insects in epidemic areas in Maryland have been unsuccessful. These attempts as well as experimental transmission studies are being continued. The arthropod field and transmission experiments are conducted in cooperation with the Department of Entomology. *(Project D-57)*

Repeated Culture and Treatment Needed for Mastitis Control

The principle behind mastitis control is to detect the quarters of bovine udders which harbor infectious agents, to find out which drugs are more effective, and then to treat these quarters. This process is repeated until the number of cows with mastitis decreases to a point which is set by the individual dairyman.

To help maintain this low level,

"strict" sanitation and milking procedures are recommended.

In over half (54%) of the mastitis cases studied, the principle organism was pathogenic *Staphylococcus sp. Streptococcus agalactiae* was found in 44% of the cases; Gram negative was *Pseudomonas sp.* and coliforms were present in 2% of the cases.

At the present time *Streptococcus agalactiae* lends itself more easily to control, and can be eradicated from farms when pursued with persistance (repeated culture and treatment).

Since mastitis is one of the most common diseases of dairy cattle, its control improves the health of cows, quality of the milk, and contributes to the efficiency of the dairy operation.

(Project D-58)

New Type Brucellosis Vaccine Shows Promise

During the spring of 1959 Maryland became a Modified Certified Brucellosis Free State. This marks further advance toward the complete eradication of the disease in the United States. However, there must be vigilance in continued calfhood vaccination and testing, to prevent its reappearance. In order to avoid wholesale slaughter, should an outbreak occur, it would be desirable to have a vaccine at hand, other than Strain 19, which would stimulate the production of immune bodies sufficiently to prevent the spread of the disease in the healthy animals. Any agglutination titer produced by such a vaccine should be transitory, so no confusion will result when making the regular brucellosis tests. Strain 19 vaccination produces such high and lasting titers in adult cattle that its use has been discontinued in this age group.

The preparation and testing of three types of vaccines has been one of the projects of the brucellosis research program. One of them contains ether-killed Brucella; another is produced from organisms which grow only in the presence of streptomycin; and the third type consists of Brucella which have been grown in embryonating eggs over long periods of time. Of the three types tested, the last mentioned seems to be the most promising. The 200th serial passage in embryonating eggs has been used in making this vaccine. These organisms kill the eggs very rapidly, but produce only a mild attack of the disease in other animals. Preliminary trials indicate that this vaccine strain may prove to be of real value in controlling brucellosis in adult cattle.

Additional information has been acquired in evaluating vaccines and vaccination through the measurement of the protective ability of blood sera in preventing death in infected embryonating eggs. Some 2500 serum samples have been studied and compared.

(Project D-60)

Develop New Technique for Study of Ruminant Metabolism

A method has been developed for the separation and quantitative estimation of many of the organic acids which participate in the intermediary metabolism of ruminant liver. A comparison of the levels of these acids in the livers of sheep having pregnancy disease with those found in the livers of normal sheep is being made. It is hoped that such data will be helpful in increasing our understanding of ruminant ketosis. *(Project D-61)*

Study Susceptibility of Bulls to Vibrio Fetus

Vibriosis has been repeatedly diagnosed in Maryland herds where natural service to herd sires is a part of the breeding program. Losses accumulate from delayed calf crops and abortions. The principal loss to the producer results from periods of infertility in the female that vary from 3 to 6 months or more. The bull is the primary agent in the transmission of the disease. Research is in progress to determine the susceptibility of bulls to different strains of Vibrio fetus. It is felt that this is necessary for studying means of prevention in the male.

Leptospirosis is a serious disease problem in cattle through the country and the infection can be transmitted to man. Studies being conducted in Maryland indicate that leptospirosis is widely distributed and probably due to a variety of *Leptospira*. Vaccine studies are in progress to evaluate products now on the market and determine if additional types are needed. *(Project D-62)*

Conduct Study in Cooperation With NIH

A cooperative study with the National Institute of Allergy and Infectious Diseases, National Institutes of Health, has been conducted to determine the causes of shipping fever and other respiratory diseases of cattle. Field studies and animal experimentation at the University of Maryland have been augmented by the tissue culture facilities available at National Institutes of Health.

A number of viruses have now been isolated from cattle and their role in disease is being determined. At least two viruses, thus far isolated, are related to agents causing human respiratory diseases. A vaccine study involving one of the viruses associated with bovine shipping fever is now in progress. The Dairy Department is cooperating in these experiments. *(Project D-63)*

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F. H. Wilcox, Ph.D., Asst. Prof. Poultry Hush.

SOCIOLOGY

W. C. Rohrer, M.S., Asst. Prof. Sociology

VETERINARY SCIENCE

A. L. Brueckner, B.S., V.M.D., Prof. and Head of Dept.
R. J. Byrne, D.V.M., Assoc. Prof. Vet. Sc.
Cornelia M. Cotton, Ph.D., Res. Assoc. Vet. Sc.
H. M. DeVolt, D.V.M., M.S., Prof. Path.
L. J. Poelma, D.V.M., M.S., Prof. Path.
R. L. Regan, Prof. Vet Virology
J. R. Sperry, D.V.M., Assoc. Prof. Vet. Sc.

FINANCIAL STATEMENT--JULY 1, 1958, TO JUNE 30, 1959

	Federal Funds			
	Amended Hatch	*Regional Research*	*Agrl. Marketing Title II*	
	$	$	$ 2,483.69	
Appropriation 1958-1959	345,414.00	97,960.00	5,500.00	
TOTALS	345,414.00	97,960.00	7,983.69	
Receipts from sources other than Federal 1958-1959				*For Agri. Investigations**
State Appropriations for Agricultural Investigations				$ 835,289.36
Special Endowments, Fellowships and Grants				112,565.96
Sales and Miscellaneous				206,801.00
				1,154,656.32
Balance brought forward July 1, 1958				80,723.11
Total				1,235,379.43
Expenditures:				
Personal Services	233,541.18	67,634.69	6,334.22	801,925.20
Travel	5,927.28	1,938.76	231.67	18,087.51
Transportation	394.84	26.82	....	683.00
Communication Service	242.90	111.40	....	5,236.29
Rents and Utility Services	855.41	833.95	....	6,943.96
Printing and Reproduction	4,378.09	662.33	47.35	7,851.35
Other Contractual Services	11,439.18	1,502.50	569.07	73,590.70
Supplies and Materials	52,568.51	13,888.61	....	176,662.13
Equipment	35,237.80	11,360.94	75.73	70,710.66
Lands and Structures	828.81	....	....	33,891.85
Contributions to Retirement	....	....	....	....
Taxes and Assessments	....	....	....	743.53
	345,414.00	97,960.00	7,258.04	1,196,326.18
Balance June 30, 1959	....	....	725.65	39,053.25
Totals	345,414.00	97,960.00	7,983.69	1,235,379.43

* Including Offset Funds

PUBLICATIONS

Bulletins

A-99 Studies of Twelve Species of Mosquitoes as Potential Vectors of Filariae Affecting Skunks, Squirrels and Raccoons in Maryland. B. R. Evans, W. G. Phillips and W. E. Bickley, 31 pp. June 1959.

A100 A Contribution to a Revision of the Culicidae of Northern Thailand. Ernestine H. B. Thurman. 187 pp. June 1959.

A101 Relation of Fertilizer Composition to Growth and Development of Maryland Tobacco. J. D. Bowling. 20 pp. June 1959.

A102 Effect of Boron Sprays on the Development of Bitter Pit in the York Imperial Apple. D. B. Dunlap and A. H. Thompson. 28 pp. June 1959.

A103 The Contribution of the Awns to the Development of the Kernels of Bearded Wheat. W. T. McDonough and H. G. Gauch. 16 pp. June 1959.

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A105 Research: Gateway to Agricultural Progress. (71st Annual Report of the Maryland Agricultural Experiment Station) I. C. Haut. 80 pp. June 1959.

465 Midland Bermudagrass—A New Forage Grass for Maryland. A. M. Decker. 21 pp. January 1959.

466 Ten Years of Forage Crop Variety Testing in Maryland, 1948-1957. R. C. Leffel, T. S. Ronningen and A. M. Decker. 47 pp. June 1959.

Scientific Journal Articles
and Miscellaneous Periodicals, Reports, Proceedings, Etc.

Department of Agricultural Economics

328 Egg Producer Practices and Market Outlets Available in Maryland. W. G. Langston and H. D. Smith. (Multigraphed Circular) 19 pp. August 1958.

329 Some Marketing Aspects of the Food Processing Industry in Maryland, Delaware and New Jersey. H. P. Stutts. (Multigraphed Circular) 19 pp. October 1958.

331 Comparative Costs of Cutting and Packaging Chicken in the Retail Store Versus the Processing Plant. H. D. Smith and J. S. Stiles. (Multigraphed Circular) 16 pp. September 1958.

345 Consignment Buying and Selling of Cattle at Auction Markets. J. N. Smith and H. D. Smith. (Multigraphed Circular) 21 pp. January 1959.

355 An Analysis of Marketing Farm Fowl and Turkey. L. H. Davis and H. D. Smith. (Multigraphed Circular) 35 pp. March 1959.

360 Capital Requirements for Mechanization in Agriculture. R. J. Beiter. (Multigraphed Circular) 24 pp. June 1959.

361 Changes and Adjustments in the Organization and Operation of Maryland Dairy Farms. J. W. Wysong. (Multigraphed Circular) 59 pp. June 1959.

Department of Animal Husbandry

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Department of Agronomy

339 Chickweed Control in Lawn. P. W. Santelmann. Proc. N. E. Weed Control Conf.—13th Annual meeting—pp. 160-161. 1959.

340 Pre-and Post-Emergence Weed Control in Field Corn. J. A. Meade and P. W. Santelmann. Proc. N. E. Weed Control Conf. 117-121. January 1959.

354 The Performance of Hybrid Corn—1958. R. G. Rothgeb. (Planographed Circular) 14 pp. February 1959.

A463 Investigation of a Thermal Method for the Determination of Fixed Potassium in Soils. J. O. Legg and J. H. Axley. Soil Sci. Soc. of Amercia Proc. 22(4):287-290. July-Aug. 1958.

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A671 Analyses of Diallel Crosses Among Ten Varieties of Soybeans. R. C. Leffel and M. C. Weiss. Agron. Jour. 50:528-534. 1958.

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Department of Botany

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Department of Dairy Husbandry

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A732 Effect on Rumen Volatile Fatty Acids and Rumen Microbial Dissimilation of Glucose -C^{14} of Corn Meal When Fed Exclusively and in Combination with Hay or Certain Additives. A. N. Eusebio, J. C. Shaw, E. C. Leffel, S. Lakshmanan and R. N. Doetsch. Jour. Dairy Sci. 42(4):692-697. April 1959.

Department of Entomology

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A699 Surfacing Time as a Simple Criterion of Normality in *Anopheles* larvae. J. C. Jones. Mosquito News 18(4):325-326. December 1958.

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A708 Observations on the Anatomy and Physiology of the Ovaries of *Aedes ageypti* L. J. C. Jones. Anatomical Record 132(3): 460. November 1958.

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A713 Notes on the Biology of the Asiatic Oak Weevil in Maryland. Robert Evans. Jour. Econ. Entomol. 52(1):177. February 1959.

A731 The Effectiveness of Some Insecticides on Several Vegetable Crops. J. R. Young and L. P. Ditman. Jour. Econ. Entomol. 52(3):477-481. June 1959.

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Department of Horticulture

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Department of Poultry Husbandry

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Department of Sociology

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Department of Veterinary Science

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Miscellaneous

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A659 Some Statistical Aspects of the Relationship of Quail Density to Farm Composition. Vincent Schultz and S. H. Brooks. Jour. Wildlife Mgmt. 22(3):283-291. July 1958.

CURRENT PROJECTS

(These are project listings and not publications available to the public)

Project Number	*Department of Agricultural Economics and Marketing*
A-18-al	An Economic Study of Maryland Dairy Farms. J. W. Wysong and R. R. Robinson.
A-18-am	An Analysis of Alternative Adjustments in Farm Organization. Sidney Ishee and G. N. Nuckols, Jr.
A-18-an	An Economic Analysis of Cage and Floor Methods of Commercial Egg Production. R. A. Murray and graduate assistant.
A-18-ao	An Analysis of Cost of Forage Storage Structures on Dairy Farms. J. W. Wysong and John Gale.
A-18-ap	Economic Profitability of Vegetable Production in Maryland. Sidney Ishee and H. H. Hoecker.
A-18-aq	Economic Effects of Vertical Integration on the Production and Marketing of Maryland Farm Products. Sidney Ishee and Robert Hamby.
A-19-p	Factors Affecting the Cost of Certain Kinds of Insurance to Farmers. W .P. Walker, P. R. Poffenberger, F. E. Hulse and Sidney Ishee.
A-19-t	Capital Requirements in Agriculture. Sidney Ishee, R. J. Beiter, P. M. Overholtzer and P. R. Poffenberger.
A-19-u	The Effects of Property Tax Assessment and Exemption Practices on Maryland Farmers and on State Aid Equalization Programs. W. P. Walker, Sidney Ishee and R. S. Poffenberger.
A-19-v	An Analysis of the Distribution of Highway-User Taxes for Rural and Urban Highways in Maryland. W. P. Walker.
A-26-am	Alternative Merchandising and Promotional Methods Affecting Demand for Poultry Meat. H. D. Smith and J. S. Stiles.
A-26-an	Relation of Various Livestock Marketing Methods to Producer Returns. H. D. Smith, J. N. Smith and H. H. Harp.
A-26-at	A Study of Egg Marketing in Maryland. H D. Smith and W. G. Langston.
A-26-au	Marketing of Maryland Sweet Potatoes. G. M. Beal, H. H. Hoecker and Ray Voelkel.
A-26-aw	Pooling Arrangements and Quota Plans in Maryland Fluid Milk Market. G. M. Beal and K. N. Adams.
A-26-ax	Market Outlets and Methods of Marketing Chickens and Turkeys from Farm Flocks. H. D. Smith, R. J. Beiter and L. H. Davis.
A-26-ay	Improving Techniques of Market Preparation and Grading of Maryland Tobacco. G. M. Beal, Morley Jull and Keith Park.
A-26-az	An Economic Analysis of Soybean Marketing in Maryland. R. E. Bell, Bhagwant Singh and C. C. Taylor.
A-26-b	Membership Relations and Educational Programs of Farmer Cooperatives in Maryland. R. J. Beiter and graduate assistant.
A-32-f	Farm Tenancy and Leasing Arrangements in Maryland. L. B. Bohanan, S. H. De Vault and Sidney Ishee.
A-32-h	Effects of Drainage Upon Crop Yields, Farming Practices and Land Utilizations. S. H. De Vault, L. B. Bohanan, H. A. Zeigler and Sidney Ishee.
A-32-j	Problems Associated with Farm Irrigation in Maryland. Sidney Ishee.
A-34	An Analysis of the Processing and Marketing Costs for Selected Processing Vegetables Grown in the Tri-State Area. D. A. Swope and L. C. O'Day.

Department of Agricultural Education

T-4	The Role of Educational Campaigns in Removing Safety Hazards from Farms. H. P. Hopkins and A. M. Ahalt.

T-5	Improving Agricultural Community Shows and Exhibits. A. M. Ahalt and H. P. Hopkins.

Department of Agricultural Engineering

R-11-d	Tobacco Housing. P. N. Winn, G. J. Burkhardt, O. E. Street and J. H. Hoyert.
R-11-e	Structures and Equipment for Tobacco Stripping. P. N. Winn, G. J. Burkhardt, O. E. Street and J. H. Hoyert.
R-16	Pneumatic Handling of Chopped Forage. G. J. Burkhardt, K. E. Felton, E. W. Martin and J. E. Foster.
R-17	Drying Shelled Corn with Unheated Air in Maryland. G. J. Burkhardt, E. W. Martin, L. F. George and R. G. Rothgeb.
R-18	Development of Equipment and Improved Methods for Harvesting Sweet Potatoes. G. J. Burkhardt and E. W. Martin.

Department of Agronomy

B-43	Soybean Culture and Varietal Improvement. R. C. Leffel, R. G. Rothgeb, W. G. Barber and W. D. Henson.
B-50	Breeding for Better Dent Corn. R. G. Rothgeb and staff assistants.
B-56-a	Red Clover Improvement. A. M. Decker, T. S. Ronningen, C. H. Liden and R. C. Leffel.
B-56-g	Ladino Clover Breeding. T. S. Ronningen, A. M. Decker and R. C. Leffel.
B-56-i	Breeding Orchard Grass for Maryland. T. S. Ronningen, A. W. Burger, A. M. Decker and R. C. Leffel.
B-56-j	Pasture Species for Beef Production. A. M. Decker and J. E. Foster.
B-56-l	Variety and Strain Testing of Forage Legumes and Grasses in Maryland. T. S. Ronningen, A. M. Decker, C. H. Liden and R. C. Leffel.
B-56-m	Seedling Establishment and Management of Legumes and Grasses. A. M. Decker and N. A. Clark.
B-56-n	Alfalfa and Alfalfa-Orchard Grass Management. A. M. Decker.
B-58-c	Weed Control in Legumes. A. O. Kuhn, J. A. Meade, T. L. Bissell, W. C. Hulburt and P. W. Santelmann.
B-58-e	The Use of Chemical and Cultural Methods to Control Weeds in Field Crop or Turf Areas. P. W. Santelmann and J. A. Meade.
B-66	Wheat Improvement for Maryland. R. G. Rothgeb, J. L. Newcomer, J. H. Axley and staff assistants.
B-67	Improvement of Small Grains for Feed. R. G. Rothgeb and staff assistants.
B-68	Effect of Rotational Practices Involving Various Legumes on the Growth, Quality and Composition of the Maryland Tobacco. O. E. Street, C. G. McKee, J. H. Hoyert, C. S. Slater and L. B. Nelson.
B-69	Breeding for Mildew Resistance in Winter Barley and Wheat. R. G. Rothgeb and M. M. Cohen.
B-70	A Study of the Growth Characteristics of Foxtail (Setaria spp.) as Related to Chemical Control Measures. P. W. Santelmann and J. A. Meade.
B-71	Performance of Grain Sorghum Hybrids in Maryland. R. G. Rothgeb and staff assistants.
B-72	Evaluation of Varietal Purity and Identity of Seeds of Improved Strains of Alfalfa Red Clover, Birdsfoot Trefoil and Orchard Grass. J. L. Newcomer.
BOQR-84	Climatological Relationships to Plant Growth Employing Supplemental Irrigation. In cooperation with Agrl. Engineering and Horticulture Departments. O. E. Street, A. M. Decker, R. E. Wagner, Edward Strickling, Francis Stark, R. L. Green, P. W. Winn, L. D. Nelson, N. H. Engelbrecht and M. L. Blanc.
O-48	Classification and Correlation of Maryland Soils with Special Emphasis on

Morphology, Fertility and Conservation and the Interdependence of These Factors. G. A. Bourbeau, Michael Redgrave and Ray Zarza.

O-51 Alfalfa Fertilizer Practices. J. H. Axley.

O-54 Mineralogical Studies of Maryland Soils. G. A. Bourbeau, V. T. Vallassis, J. G. Parker and J. R. Chaves.

O-55 Study of Soil Tests to Improve Their Accuracy and Reliability. J. H. Axley.

O-56 Factors Affecting the Formation and Destruction of Soil Aggregates. Edward Strickling, Michael Redgrave, T. C. Olson and R. O. Gifford.

O-58 Corn Stalk Rot Incidence as Affected by Various Rates of Fertilization. C. B. Kresge.

O-59 Response of Orchardgrass to Various Rates and Ratios of Potassium and Nitrogen Fertilization. C. B. Kresge.

O-60 The Effect of Various Rates and Frequencies of Potassium Applications on Yield, Persistence and Chemical Composition of Alfalfa and Alfalfa-Orchardgrass. C. B. Kresge.

O-61 Comparison of the Effect of Several Nitrogen Sources on Yield and Nitrogen Content of Grass Under Field Conditions. C. B. Kresge.

Department of Animal Husbandry

C-14 A Study of the Productiveness of Purebred Beek Cattle in Maryland. W. W. Green, J. E. Foster, M. E. Gannon and J. B. Lingle.

C-14-a Effect of Early Weaning on the Duration of Maternal Influences in Beef Calves. W. W. Green, J. E. Foster and W. R. Harvey.

C-14-d Group Versus Individual Feeding of Weaned Beef Calves. John Buric, J. E. Foster and J. R. Sperry.

C-21 The Effect of Specific Metabolites Upon Growth Rate and General Condition of Sheep. E. C. Leffel and W. H. Brown.

C-23 A Study of the Effect of Protein Level on the Reproductive Performance of Female Swine. E. P. Young, F. C. Wingert, W. W. Green, J. E. Foster and M. E. Gannon.

C-24 A Study of the Presence and Control of Internal Parasites in Swine. E. P Young, F. C. Wingert, W. W. Green, J. E. Foster, M. E. Gannon, M. B Guidotti and J. R. Sperry.

C-25 A Study of Rumen Metabolism in the Sheep. E. C. Leffel, W. H. Brown. R. J. Komarek, J. E. Foster, Sitarama Lakshmanan and J. C. Shaw.

C-25-a The Effects of Roughage Preparation. E. C. Leffel, R. J. Komarek and J. E Foster.

C-26 Studies of the Protein and Energy Requirements of Growing-Fattening Swine. E. P. Young, F. C. Wingert and J. E. Foster.

C-27 A Study of Growth Promoting Properties of Certain Feed Adjuvants. E. P. Young, F. C. Wingert and J. E. Foster.

C-28 A Study of the Effect of the Form in Which Feeds are Fed to Swine. E. P Young, F. C. Wingert and J. E. Foster.

C-29 A Study of the Effects of Method of Feeding and of Different Protein Supplements for Growing-Fattening Swine. E. P. Young, F. C. Wingert and J. E Foster.

C-30 Comparison of Methods for the Diagnosis of Bovine Pregnancy. W .W. Green, H. W. Tavenner, J. E. Foster and J. R. Sperry.

C-31-a Comparison of Pelleted versus Unpelleted Barley for Feeding Weaned Beef Calves. John Buric, J. E. Foster, E. C. Leffel, W. W. Green and M. E. Gannon.

C-31-b Comparison of Morea versus Oil Meal as a Supplement for Feeding Weaned Beef Calves. John Buric, J. E. Foster, E. C. Leffel, W. W. Green and M. E. Gannon.

C-32 A Study of the Value of Systemic Insecticides in the Control of Ox Warbles, *Hypoderma lineatum* (DeVill.) and H. bovis (L.). John Buric, J. E. Foster, E. C. Leffel, W. W. Green, M. E. Gannon and W. T. Johnson.

Department of Botany

F-12 The Native Plants of Maryland, Their Occurrence, Distribution and Economic Importance. R. G. Brown and Edith Scott.

F-15-b Spontaneous and Induced Multiple Seedlings and Haploids of *Zea Mays Capsicum Frutescens* and Other Economic Plants and Their Use in Plant Breeding. D. T. Morgan, Jr., R. D. Rappleye, Lois Carleton and Robert Grant

F-16 Cytological and Genetical Studies in Ornamental and Crop Plants. R. D. Rappleye, D. T. Morgan, Jr., Lois Carleton and Robert Grant.

F-17 Forest Tree Improvement by Chromosome Doubling of Haploid Sporophytes R. D. Rappleye and graduate assistants.

J-86-a The Nature and Control of Sweet Potato Diseases Occurring in Maryland Including Studies on Significance of Microbiological Antagonism. W. F. Jeffers, C. E. Cox, J. G. Kantzes and graduate assistant.

J-91 Evaluation of Fungicides for the Control of Diseases of Vegetable Crops. C. E. Cox, H. D. Sisler, J. G. Kantzes, L. O. Weaver and graduate assistants.

J-92 Development of Antibiotic Substances for Control of Plant Pathogenic Organisms. W. F. Jeffers, H. D. Sisler, C. E. Cox, R. A. Paterson and graduate assistants.

J-93 Treatment of Soil and Underground Parts of Plants for the Control of Plant Diseases. O. D. Morgan, C. E. Cox, W. R. Jenkins, J. G. Kantzes, J. B. Wilson and R. C. Leffel.

J-95 Development of Improved Strains of Maryland Tobacco Resistant to Diseases. O. D. Morgan, J. R. McGrew, O. E. Street, J. H. Hoyert, E. E. Clayton and Howard Heggestadt.

J-96 Occurrence, Distribution, Biology and Control of Plant Parasitic Nematodes in Maryland. W. R. Jenkins, R. A. Rohde and graduate assistants.

J-97 Biology and Control of Nematodes Associated with Plant Diseases. W. R. Jenkins, R. A. Rohde and graduate assistants.

J-98 Identification, Characterization and Control of Certain Virsuses Affecting Economic Plants in Maryland. H. D. Sisler, C. E. Cox, O. D. Morgan and F. E. Cooper.

J-99 The Nature and Control of Root Rots Involved in Decline of Boxwood and other Woody Ornamental Plants in Maryland. J. B. Wilson, W. R. Jenkins and graduate students.

K-8-c The Role of Trace Elements in Plant Nutrition. H. G. Gauch, W. W. Dugger, Jr., R. W. Krauss and graduate assistants.

Department of Dairy Husbandry

G-34 Chemical Changes in Milk Fat as Related to the Flavor of the Milk. Mark Keeney and R. L. King.

G-35 The Analysis of Dairy Products. Mark Keeney and Ira Katz.

G-37 Ketosis and Parturient Paresis in Dairy Cows. J. C. Shaw, E. C. Leffel and R. D. McCarthy.

G-38 Physiology of Milk Secretion. J. C. Shaw and J. B. Holter.

G-39 A Study of Factors Affecting the Availability and Utilization of Nutrients in Feeds and Their Influence Upon Body Composition, Growth and Milk Secretion. J. C. Shaw, R. L. King, R .W. Hemken and William Ensor.

G-40 Influence of High Temperature Heat Treatment on Certain Physical and Chemical Properties of Milk. Mark Keeney.

G-42	Methods of Processing and Other Factors Affecting the Quality of Ice Cream. W. S. Arbuckle and William Venter, Jr.
G-43	The Metabolism of Acetate, B-hydroxybutyric Acid, Glucose and Other Carbon Compounds in Lactating Ruminants. J. C. Shaw, R. D. McCarthy and Sitarama Lakshmanan.
G-46	The Relationship of the Hypophyseal Growth Hormone and of the Pituitary-Adrenal System to the Productive Capacity of Dairy Cattle for Reproduction and Milk Production. J. C. Shaw, F. G. Hueter and W. F. Williams.
G-47	Nutritive Evaluation of Forages. R. W. Hemken, R. F. Davis and A. M. Decker.
G-48	Flavor Quality of Concentrated Milk Products as a Factor in Milk Utilization and Marketing. Mark Keeney.
G-50	The Physiology of Mammary Gland Growth and Development and the Initiation and Maintenance of Lactation with Particular Reference to Endocrine Relationships. W .F. Williams.
GC-45	A Study of the Causes and Prevention of Bloat in Ruminants. E. C. Leffel, R. N. Doetsch, W. H. Brown, P. J. Provost and P. P. Williams.

Department of Entomology

H-29-l	Chemical Control of Bean Insects: Evaluation of Commercial Treatments and Investigations of New Insecticides. L. P. Ditman, G. J. Burkhardt, Francis Stark and Charles Reynolds.
H-29-m	Chemical Control of Insect Pests of Sweet Corn. L. P. Ditman and F. P. Harrison.
H-35-a	Nursery Insects. The Euonymus Scale. W. T. Johnson and W. E. Bickley.
H-35-b	Nursery Insects. The Control of Arthropod Pests of Azalea with Systemic Insecticides. W. T. Johnson and W. E. Bickley.
H-46-e	Continued Studies on the Efficiency of Fixed-Boom Low-Volume Sprayers and the Development of New Insecticides. L. P. Ditman, G. J. Burkhardt, J. T. Whitlaw, W. E. Bickley and graduate students.
H-48	Control of the Codling Moth and Careful Observations on Possibility of Resistant Strains. W. E. Bickley, Castillo Graham and E. R. Krestensen.
H-56	Patuxent Project on the Effect of Soil Conservation Upon Insect Populations. H. B. Owens, L. P. Ditman and W. E. Bickley.
H-60	Biology and Control of Nut Weevils. W. T. Johnson.
H-61	The Biology and Distribution of *Macropsis Trimaculata* Fitch. W. E. Bickley, Castillo Graham and E. R. Krestensen.
H-64	An Evaluation of the Effectiveness of Commercial Insect Control Practices on Canning Crops. L. P. Ditman.
H-65	Formulation of Sprays for the Home Garden. J. R. Young and L. P. Ditman.
H-66	The Effectiveness of Some Chlorinated Organic Insecticides When Applied to the Soil. L. P. Ditman, Harold Gibson and F. P. Harrison.
H-67	Factors Influencing Spray Deposits on Some Vegetable Crops. L. P. Ditman, J. T. Whitlaw, Jr., W. E. Bickley, G. J. Burkhardt and Amihud Kramer.
H-69	Identification and Control of the Various Species of Mites Causing Damage to Apple Orchards. W. E. Bickley, Castillo Graham and E. R. Krestensen.
H-70	Study of the Seasonal History, Parasites and Control of the Unspotted Tentiform Leaf Miner *Callisto* (Parornix) *geminatella* Pack. W. E. Bickley, E. R. Krestensen and Castillo Graham.
H-71-a	Investigation of Forage Crop Insects. The Clover Root Curculio. L. P. Ditman and W. G. Phillips.
H-71-b	Investigation of Forage Crop Insects. Chemical Control of Insects Attacking Alfalfa. W. E. Bickley, T. L. Bissel, W. G. Phillips and L. P. Ditman.

H-71-c	Insects Affecting Soybeans. W. E. Bickley, A. L. Steinhauer, T L. Bissel and R. H. Ratcliffe.
H-72	Physiology of Insect Reproduction. J. C. Jones and graduate assistants.
H-73-a	Bionomics of Maryland Mosquitoes: The Mosquito Fauna in Selected Swamps, Marshes and Impoundments. W. E. Bickley and P. M. Brickey, Jr.
H-73-b	Bionomics of Maryland Mosquitoes: Vectors of Filariae Affecting Certain Wild Mammals. W. E. Bickley, W. G. Phillips and B. R. Evans.
H-73-c	Bionomics of Maryland Mosquitoes: Feeding Habits of Maryland Mosquitoes in Relation to Eastern Equine Encephalitis. W. E. Bickley and graduate students.
H-74	Biology and Control of Tobacco Insects. F. P. Harrison.
H-75	The Taxonomy of the *Aspidiotus howardi* Ckll. Complex (Homoptera: Coccoidea) J. A. Davidson and W. E. Bickley.
H-76	Comparative Morphology and Physiology of Insect Blood Cells. J. C. Jones and graduate students.
H-77	The Susceptibility of the Red-Banded Leaf Roller, *Argyrotaenia velutinana* (Wlkr.) to TDE. E. R. Krestensen, Castillo Graham and W. E. Bickley.
QH-58-o	Evaluation of Possible Off-Flavors Resulting from the Application of Chemicals on Soils and Growing Crops. (Cooperation with Horticulture Department) Amihud Kramer, L. P. Ditman and R. C. Wiley.

Home Economics — Department of Foods and Nutrition

Y-1	Interrelationships in the Metabolism of Different Levels of Protein and Fat in the Diet of College Women. Pela Braucher, D. G. Snyder, L. M. Dyke, Virginia Dawson, Genevieve Watkins, Dorothy Newquist and Vincent Schultz.

Department of Horticulture

BQ-83	Yield and Quality of Selected Crops Receiving Supplemental Irrigation, Including Relationships of Moisture to Species, Fertilizer and Cultural Practices. (Cooperation with Agronomy and Agricultural Engineering Departments) O. E. Street, A. M. Decker, C. W. Reynolds and F. C. Stark.
I-74-a	Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Greenhouse Potted Plants. J. B. Shanks and C. B. Link.
I-74-b	Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Greenhouse Cut Flower Crops. C. B. Link and J. B. Shanks.
I-79-h	The Relationship of the Mineral Nutrients and of Nutrient Levels to the Growth and Flowering of the Azalea Under Greenhouse Conditions. C. B. Link and J. B. Shanks.
I-79-i	The Balance and Intensity of Inorganic Nutrient Elements as they Affect the Growth, Flowering and Quality of *Hydrangea Macrophylla* Thunb. Under Greenhouse Conditions. J. B. Shanks and C. B. Link.
L-73	Adaptation of Fruit Varieties and New Seedlings to Maryland. I. C. Haut, F. J. Lawrence, A. H. Thompson and Gene Stembridge.
L-74	Environmental Factors and Cultural Practices in Relation to the Growth and Fruiting Responses of Fruits. A. H. Thompson, L. E. Scott, F. J. Lawrence, B. L. Rogers, S. H. Todd and I. C. Haut.
L-74-b	Chemical Thinning of Apples and Peaches. A. H. Thompson, B. L. Rogers and E. A. Stahly.
L-79-a	Relation of the Level of Mineral Nutrients in the Plant to Growth and Fruiting of the Strawberry: with Particular Reference to Nitrogen. L. E. Scott, Glen Stadelbacher, W. A. Matthews and I. C. Haut.
Q-58-f	Development of Objective Grades and Standards and Quality Control Methods for Vegetables. Amihud Kramer, B. A. Twigg, R. C. Wiley, L. E. Scott, F. C. Stark, H. S. Todd, I. C. Haut and G. J. Burkhardt

Q-58-n Suitability of New Varieties of Horticultural Crops for Canning and Freezing. W. L. Hollis, B. A. Twigg, Amihud Kramer, F. C. Stark, L. E. Scott and R. C. Wiley.

Q-58-q Bulk Packaging and Shipping of Raw Vegetables. Amihud Kramer, L. E. Scott, William Cooler and G. J. Burkhardt.

Q-74 A Study of Regional Adaptation of Certain Vegetable Crops and Varieties in Maryland. W. L. Hollis, F. C. Stark, C. W. Reynolds, L. E. Scott and W. A. Matthews.

Q-77 Crop Management Studies with Vegetable Crops. W. L. Hollis and F. C. Stark.

Q-79-b The Mineral Levels and Interrelationships of Mineral Nutrients in Fruit Plantings in Maryland. A. H. Thompson, L. E. Scott, B. L. Rogers, I. C. Haut. D. R. Heinicke, D. B. Dunlap and J. A. Barden

Q-79-g Changes in Chemical Composition of the Sweet Potato During Development Storage and Processing as Related to Quality to the Final Product. L. E. Scott, W. A. Matthews, F. C. Stark and R. A. Baumgardner.

Q-79-h Influence of Nutrient Intensity and Balance on the Growth, Yield and Quality of Cauliflower. C. W. Reynolds and F. C. Stark.

Q-81 Cantaloupe Breeding and Selection with Particular Reference to Quality and Resistance to Defoliation. F. C. Stark and W. A. Matthews.

Q-81-b Sweet Potato Breeding and Selection with Particular Reference to Quality and Resistance to Defoliation. F. C. Stark, W. A. Matthews and L. E. Scott.

Q-81-c Sweet Corn Breeding with Particular Reference to the Utilization of Cytoplasmic Male Sterility in the Production of F_1 Hybrid Seed Corn. R. J. Snyder and F. C. Stark.

Q-82 Tomato Breeding and Selection with Particular Reference to Greater Resistance to Cracking and to Late Blight. F. C. Stark and W. A. Matthews.

Q-84 Effect of Modified Atmosphere Upon the Storage Behaviour of the Sweet Potato. T. L. Senn, L. E. Scott and W. A. Matthews.

Department of Poultry Husbandry

M-32-l Study of Factors Influencing or Controlling the On-Set of Molt. Mary Juhn, P. C. Harris and C. S. Shaffner.

M-32-m Genetic Differences in Alkaline Phosphatase Concentration of Blood Sera as Related to Differences in Egg Production and Egg Quality. F. H. Wilcox, S. S. Shaffner and Yuichi Tanabe.

M-33-e Genetic Control of Serum Cholesterol Level. F. H. Wilcox, C. S. Shaffner, P. C. Harris, L. B. Hardy and R. E. Seagrave.

M-34-e Selective Breeding of Medium Sized Turkeys for Improvement of Economic Qualities. C. S. Shaffner and G. D. Quigley.

M-35-m Development of Improved Rations and Feeding Methods for Laying Chickens. G. F. Combs, W. C. Supplee, R. H. Creek, N. V. Helbacka, D. F. Middendorf and D. L. Blamberg.

M-48 Microbiological Studies Pertaining to Poultry Nutrition. Mary S. Shorb, Pauine Lund and Helen M. Walker.

M-49 Vitamin B_{12} and Chick Nutrition. Mary Shorb, Unabelle Blackwood and W. O. Pollard.

M-50 The Effect of Rapid Changes in Ambient Temperature on Egg Production. C. S. Shaffner, F. H. Wilcox, G. D. Quigley and A. C. Campos.

M-51 Development of Improved Objective Methods for Detecting Meat Spots in the Hen's Egg as Related to Quality in Egg Marketing. N. V. Helbacka.

M-53 A Study of the Relationships Between High Ambient Temperature and the Shell Thickness of Market Eggs. N. V. Helbacka and K. N. Hall.

M-54	Studies on Energy Requirements of Poultry and the Energy Content of Poultry Feed Ingredients. G. F. Combs and E. H. Bossard.
M-55	The Perception and Preference of Chickens for Different Colors. G. D. Quigley.
M-100	Quality Retention in Poultry Meats as Influenced by Methods of Processing. N. V. Helbacka, Sumner Patcher, C. S. Shaffner and Mary Juhn.
M-200	Studies on Improved Broiler Nutrition. G. F. Combs, J. L. Nicholson, N. V Helbacka, R. D. Creek, E. C. Quillin and O. D. Keene.
M-201	Vitamins and Unidentified Organic Factors in Poultry Nutrition. G. F. Combs, R. D. Creek, W. C. Supplee and E. C. Quillin.
M-202	Protein and Amino Acids in Poultry Nutrition. G. F. Combs, D. F. Middendorf, R. D. Creek, P. F. Twining and D. L. Pope.
M-203	Trace Minerals in Poultry Nutrition. G. F. Combs, W. C. Supplee, R. D. Creek, N. V. Helbacka, D. L. Blamberg and O. D. Keene.
M-204	Nutrition and Bone Anomalies in Chicks and Turkeys. R. D. Creek.
M-300	Factors Affecting the Fertilizing Ability of Chicken Semen. F. H. Wilcox, C. S. Shaffner, C. E. Clark, G. C. Harris and R. E. Seagrave.

Department of Sociology

S-3	Studies in the Population of Maryland. W. C. Rohrer and R. K. Hirzel.
S-3-2	Population Change in Maryland and the Northeast. W. C. Rohrer and R. K. Hirzel.
S-5	Farmer's Attitudes Toward Farming: A Comparative Study of Farm Enterprizes. W. C. Rohrer and N. L. LeRay.

Department of Veterinary Science

D-52	Investigations of Newcastle Disease in Poultry. Respiratory Disease of Poultry. H. M. DeVolt, P. J. Vasington and A. P. Holst.
D-57	Epizootiology of Equine Encephalitis in Maryland. R. J. Byrne, F. S. Yancey, Frank Hetrick and Manabu Ogata.
D-58	Infectious Bovine Mastitis. James Kornder.
D-59	An Investigation of "Air-Sac Infection" in Poultry. H. M. DeVolt and R. M. Smibert.
D-60	Investigations on Brucellosis of Cattle. Cornelia Cotton, Claire B. Wolford. Gertrude M. Jones and Dennis Hosey.
D-61	A Study of Ruminant Metabolism with Emphasis Upon its Relation to Ketosis. R. B. Johnson.
D-62	Pathology of Breeding Failures in Cattle. G. J. Plumer and William Duvall.
D-63	Study of Bovine Respiratory Diseases. L. J. Poelma, R. J. Byrne, Sing Chen Chang and Francis Abinati.

Visitors will be welcome at all times, and will be given every opportunity to inspect the work of the Agricultural Experiment Station in all its departments.

The bulletins and reports of the Station will be mailed free of charge to all residents of the State who request them.

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